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**U.S. Environmental Protection Agency
Region II**

**Draft
Focused Feasibility Study**

**NL Industries, Inc. Superfund Site
Operable Unit 2**

Pedricktown, New Jersey

July 1991

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EXECUTIVE SUMMARY

NLD 001 0301

EXECUTIVE SUMMARY

The U.S. Environmental Protection Agency (EPA) has conducted a Focused Feasibility Study (FFS) of remedial alternatives for several areas of hazardous surface contamination at the NL Industries, Inc. (NL) Superfund site located in Pedricktown, New Jersey. This study was performed under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended, and the National Contingency Plan (NCP).

Recognizing the size and complexity of the site, EPA is addressing site remediation in phases, or operable units. This FFS addresses the remediation of several areas of hazardous surface contamination which EPA has designated as Operable Unit Two. These areas, which include slag and lead oxide piles, debris and contaminated surfaces, and contaminated standing water and sediments, were found to be significant and continual sources of contaminant migration from the site. As a result, EPA decided to address these areas on an expedited basis that would be consistent with the long-term remedy for the site and would continue the site-stabilization and remediation efforts which were initiated under a Removal Action. The Early Remedial Action for Operable Unit II will prevent further releases of contaminants from areas of hazardous surface contamination and can be implemented while the site-wide RI/FS (Operable Unit I) proceeds.

The FFS develops and screens potential remedial alternatives for an Early Remedial Action. A detailed analysis of alternatives was performed to provide the basis for selecting an action that will effectively mitigate several areas of hazardous surface contamination. The evaluation of remedial alternatives was based on sampling conducted during the site-wide RI/FS, the Removal Action and the FFS.

Tables E-1, E-2, and E-3, which follow, summarize the evaluation of the remedial alternatives according to the seven criteria that were used to evaluate them. The evaluation was used to choose an appropriate remedy to address the problems posed by the slag and lead oxide materials, debris and contaminated surfaces, and contaminated standing water and sediments. Further description, discussion and analysis of the alternatives are presented in Chapters 4 and 5.

TABLE E-1

SUMMARY OF REMEDIAL ALTERNATIVES FOR SLAG AND LEAD OXIDE MATERIALS

Criteria	Alternative SP-1 No Action	Alternative SP-3 Off-Site Flame Reactor	Alternative SP-4 On-Site Hydro-Metallurgical Leaching/On-Site Disposal
Key Components	Long-term monitoring, 5-year reviews. Public awareness and education programs.	Off-site treatment of 9,800 and 200 cy of slag material and lead oxide material, respectively, at a RCRA per- mitted flame reactor facility. Possibly recycle treated material as fill material or road aggregate.	On-site treatment of 9,800 and 200 cy of slag material and lead oxide material, respectively, using a hydro-metallurgical leaching process. TCLP testing of treated material, followed by disposal in protective manner in accordance with RCRA treatment standards.
1. <u>Overall Protection of Human Health and the Environment</u>	There is essentially no reduc- tion in toxicity, mobility or volume of contaminants. Contaminant migration is monitored but risk is not reduced. Migration of contaminants from the slag and lead oxide mater- ials to the surface water, groundwater, soil and air would continue. This alternative does not meet any of the remedial objectives and therefore is not protective of human health and the environment.	The removal and treat- ment of the slag and lead oxide materials would reduce the toxicity, mobility and volume of hazardous contaminants in the materials, thereby significantly reducing the potential risks to human health and the environment. Results in overall, permanent protection of human health and the environment.	May reduce the public health and environmental risks associated with concerned exposure pathways, and may result in overall protection of human health and the environment. The uncertainty associated with this alterna- tive exists due to the pre- sence of multiple metals. Technology never used on these types of materials. Treatability studies would be performed to determine if treatment objectives can be achieved.
2. <u>Compliance with ARARs</u>	Would not comply Contaminants remain on-site.	Would comply. Removes slag and lead oxide materials from the site.	May comply. Some uncertainty exists due to multiple contaminants.

TABLE E-1

SUMMARY OF REMEDIAL ALTERNATIVES FOR SLAG AND LEAD OXIDE MATERIALS

Criteria	Alternative SP-1 No Action	Alternative SP-3 Off-Site Flame Reactor	Alternative SP-4 On-Site Hydro-Metallurgical Leaching/On-Site Disposal
3. <u>Long-Term Effectiveness</u>			
o Magnitude of residual risks	Source would not be removed or treated. Existing risk would essentially remain. Natural attenuation is very slow process for type of contaminants involved and would lead to surface and groundwater contamination.	Slag and lead oxide materials would be removed and treated off-site, therefore, no residual risk remains.	After remediation is completed there are minimal remaining risks.
o Adequacy of controls	Potential exposures remain the same.	Flame reactor technology is proven for electric furnace dust, but being tested for CERCLA waste.	Treatability studies would be performed to test if treatment objectives can be achieved. Assuming these objectives can be met, then these technologies would adequately handle these types of contaminants.
o Reliability of Control	Monitoring program is reliable to assess contaminant migration.	These operations are considered reliable for handling metal wastes.	Assuming treatability studies show that treatment objectives could be met, then these technologies would be reliable processes for handling the slag and lead oxide materials. Some uncertainty associated with multiple contaminants.
4. <u>Reduction of Toxicity, Mobility and Volume Through Treatment</u>			
o Treatment process and remedy	No treatment employed, conditions (toxicity, mobility and volume of contaminant) remain the same.	Slag and lead oxide materials would be eliminated as a source of contamination.	Same as Alternative SP-3, assuming treatability studies show that treatment objectives would be met.
o Amount of hazardous material destroyed or treated.	None by treatment. Natural attenuation continues to take place.	Approximately 9,800 and 200 cy of slag and lead oxide material, respectively removed and treated off-site.	Approximately 9,800 and 200 cy of slag and lead oxide materials removed and treated assuming treatability studies demonstrate that treatment objectives could be met.

TABLE E-1

SUMMARY OF REMEDIAL ALTERNATIVES FOR SLAG AND LEAD OXIDE MATERIALS

Criteria	Alternative SP-1 No Action	Alternative SP-3 Off-Site Flame Reactor	Alternative SP-4 On-Site Hydro-Metallurgical Leaching/On-Site Disposal
4. <u>Reduction of Toxicity, Mobility and Volume Through Treatment</u> (Cont'd)			
o Reduction of toxicity, mobility and volume (TMV).	None by treatment.	Complete reduction of toxicity, mobility and volume of contaminants in slag and lead oxide material.	Same as Alternative SP-3 assuming treatability studies demonstrate that treatment objectives could be met.
o Irreversibility of treatment	No treatment involved.	Treatment process is irreversible.	Treatment process is irreversible.
o Type and quantity of treatment residues	All the contaminants remain on site.	No treatment residues on site. Treated slag and lead oxide could possibly be recycled.	Minimal contaminated residues remain in treated residues. Treated residue is expected to pass TCLP.
5. <u>Short-Term Effectiveness</u>			
o Protection of community during remedial actions	Short-term risk to community is not applicable since no remedial action involved.	Temporary increase in direct contact risks and inhalation of fugitive dust to community. Dust control measures would be provided.	Same as Alternative SP-3. In addition, increased risk due to use of chemicals in on-site treatment.
o Protection of workers during remedial actions	No significant short-term risk.	Increased risk of dermal contact and inhalation of dust to workers. However, personal protective equipment would be provided.	Same as Alternative SP-3, only slightly increased risk due to performance of treatment on site.

TABLE E-1

SUMMARY OF REMEDIAL ALTERNATIVES FOR SLAG AND LEAD OXIDE MATERIALS

Criteria	Alternative SP-1 No Action	Alternative SP-3 Off-Site Flame Reactor	Alternative SP-4 On-Site Hydro-Metallurgical Leaching/On-Site Disposal
o Environmental impacts	Continued contamination of surface water, groundwater, soils and air from existing conditions.	Increase in traffic, noise and dust due to remedial activities. Erosion and sediment control measures would be provided to minimize contaminant migration during remedial activities. In addition, potential accidents and spillage would exist during off-site transport of contaminated material.	Same as Alternative SP-3, however, slightly less traffic.
o Time until remedial response objectives are achieved	Natural attenuation takes long period of time, over 30 years. It would take 3 months to implement the monitoring and institutional programs.	Overall remediation period is approximately 18 months. Actual remediation period is estimated to be approximately 6 months.	Overall remediation period is approximately 16 months. Actual remediation period is estimated to be 4 months.
6. <u>Implementability</u>			
<u>Technical Feasibility</u>			
o Ability to construct and operate technology	No construction involved. Monitoring wells are already installed.	Technology is being-tested under EPA's SITE Program currently. The vendor envisions a full-scale unit for treating CERCLA waste to be operational in one year. Contaminated slag and lead oxide material would have to undergo a series of analyses prior to acceptance for treatment at an off-site facility.	Easy to implement on-site. Sufficient land is available on site for operation of mobile system. Bench or pilot-scale treatability study would be needed to develop design criteria.

TABLE E-1

SUMMARY OF REMEDIAL ALTERNATIVES FOR SLAG AND LEAD OXIDE MATERIALS

Criteria	Alternative SP-1 No Action	Alternative SP-3 Off-Site Flame Reactor	Alternative SP-4 On-Site Hydro-Metallurgical Leaching/On-Site Disposal
6. Implementability (Cont'd)			
o Reliability of technology	No treatment technology involved. Monitoring is reliable.	Treatment technology to date is not yet proven for CERCLA waste on a full-scale basis. However, proven for electric arc furnace dust.	Treatment technology is proven and reliable for extracting metals from ores, however, bench- or pilot-scale treatability study required to develop design criteria for slag and lead oxide materials. Treatment technology is not yet proven for CERCLA waste.
o Ease of undertaking additional remedial action, if necessary.	If monitoring indicates that future action is necessary, must go through the FS/ROD process again.	If additional slag and lead oxide material requires treatment, it can be easily removed during remedial activities.	Same as Alternative SP-3. In addition if treatment objectives are not being met, design criteria could be re-evaluated.
o Monitoring Considerations	Long-term monitoring required. Migration/exposure pathways can be monitored.	No monitoring required after remediation is completed.	Long-term monitoring is required due to disposal of treated materials on site.
<u>Administrative Feasibility</u>			
o Coordination with other agencies	Coordination required with appropriate agencies for long time period for monitoring and reviewing site conditions.	Coordination with State and local agencies required. Transportation of the waste to an off-site facility requires coordination with DOT and local traffic department.	Coordination with State and local agencies required.
<u>Availability of Services and Materials</u>			
o Availability of treatment, storage capacity and disposal services.	No treatment, storage or disposal facilities required.	Commercial facility not currently available, although it is expected to be available in a year.	Several vendors can provide mobile treatment units. Sufficient space is available on site for treatment and disposal of treated material.

TABLE E-1

SUMMARY OF REMEDIAL ALTERNATIVES FOR SLAG AND LEAD OXIDE MATERIALS

Criteria	Alternative SP-1 No Action	Alternative SP-3 Off-Site Flame Reactor	Alternative SP-4 On-Site Hydro-Metallurgical Leaching/On-Site Disposal
o Availability of necessary equipment, specialists and materials.	Equipment and specialists for monitoring and implementing public awareness program are readily available locally.	Only one vendor is available for this technology (at this time), therefore competitive bids may not be available.	All necessary equipment, specialists and materials are readily available from several vendors. However, modified design may be required for materials in question.
o Availability of technologies	None required.	Treatment technology may not be available on full-scale basis at the time of remediation.	Treatment technology is proven and readily available.
7. Costs			
o Total Capital Cost (\$)	0	4,215,100**	2,980,400
o Annual operation and maintenance (O&M) cost (\$/yr)	25,000	0**	17,000
o Present worth* (\$ based on 5.0% discount rate and 30-year period)	439,900	4,215,100**	3,269,500

* Present worth cost includes approximately \$20,000 for Alternative SP-1 and \$10,000 for Alternatives SP-4 for each five-year review and site assessment.

** This cost estimate is based on the assumption that treated materials would be recycled.
Cost may increase if markets are not available and treated material would have to be disposed of.

TABLE E-1

SUMMARY OF REMEDIAL ALTERNATIVES FOR SLAG AND LEAD OXIDE MATERIALS

Criteria	Alternative SP-5 On-Site Stabilization (Solidification)/ On-Site Disposal
Key Components	On-site stabilization/solidification of 9,800 and 200 cy of slag material and lead oxide material respectively, using mobile treatment system. TCLP testing of treated material. On-site disposal in a protective manner in accordance with RCRA treatment standards
1. <u>Overall Protection of Human Health and the Environment</u>	Achieves overall protection of human health and the environment by reducing the mobility of the contaminants. Toxicity of contaminants would be reduced due to immobilization in stabilized mass.
2. <u>Compliance with ARARs</u>	Will comply with all ARARs.
3. <u>Long-Term Effectiveness</u>	
o Magnitude of residual risks	Same as Alternative SP-4
o Adequacy of controls	These technologies are proven methods for handling these types of contaminants. Toxicity of contaminants would be released due to immobilization in stabilized mass.
o Reliability of Control	These operations are reliable processes for handling the slag and lead oxide materials.

TABLE E-1

SUMMARY OF REMEDIAL ALTERNATIVES FOR SLAG AND LEAD OXIDE MATERIALS

Criteria	Alternative SP-5 On-Site Stabilization (Solidification)/ On-Site Disposal
4. <u>Reduction of Toxicity, Mobility and Volume Through Treatment</u>	
o Treatment process and remedy	Reduction in mobility of inorganic contaminants by stabilization/solidification process.
o Amount of hazardous material destroyed or treated.	Approximately 9,800 and 200 cy of slag and lead oxide material respectively would be removed and treated on-site.
o Reduction of toxicity mobility and volume (TMV).	Mobility of contaminants would be reduced. Reduction of toxicity of contaminants due to immobilization in stabilized mass. Volume of solidified material may increase up to 40 percent depending on additives used.
o Irreversibility of treatment	Treatment process is essentially irreversible over short-term. Long-term irreversibility is not known.
o Type and quantity of treatment residues	Treatment immobilizes contaminants although immobile contaminants remain in treated material.
5. <u>Short-Term Effectiveness</u>	
o Protection of community during remedial actions	Same as Alternative SP-3. In addition, increased dust emissions due to on-site treatment.
o Protection of workers during remedial actions	Same as Alternative SP-4.
o Environmental impacts	Same as Alternative SP-4.
o Time until remedial response objectives are achieved	Overall remediation period is approximately 15 months. Actual remediation time is estimated to be 3 months.

TABLE E-1

SUMMARY OF REMEDIAL ALTERNATIVES FOR SLAG AND LEAD OXIDE MATERIALS

Criteria	Alternative SP-5 On-Site Stabilization (Solidification)/ On-Site Disposal
6. Implementability	
<u>Technical Feasibility</u>	
o Ability to construct and operate technology	Easily implementable on site using mobile treatment units. Sufficient land is available on site for operation of mobile units and disposal of treated materials.
o Reliability of technology	Stabilization/solidification technology is reliable for metal-contaminated waste. This technology is widely used for CERCLA waste.
o Ease of undertaking additional remedial action, if necessary.	Same as Alternative SP-3.
o Monitoring Considerations	Monitoring is required because treated material is disposed of on site.
<u>Administrative Feasibility</u>	
o Coordination with other agencies	Same as Alternative SP-4.
<u>Availability of Services and Materials</u>	
o Availability of treatment, storage capacity and disposal services.	Same as Alternative SP-4.
o Availability of necessary equipment, specialists and materials.	Same as Alternative SP-4.

TABLE E-1

SUMMARY OF REMEDIAL ALTERNATIVES FOR SLAG AND LEAD OXIDE MATERIALS

Criteria	Alternative SP-5 On-Site Stabilization (Solidification)/ On-Site Disposal
<u>Availability of Services and Materials</u> (Cont'd)	
o Availability of technologies	Same as Alternative SP-4.
7. <u>Costs</u>	
o Total Capital Cost (\$)	2,014,000
o Annual operation and maintenance (O&M) cost (\$/yr)	17,000
o Present worth* (\$ based on 5.0% discount rate and 30-year period)	2,303,100

* Present worth cost includes approximately \$10,000 for Alternative SP-5 for each five-year review and site assessment.

TABLE E-2

SUMMARY OF REMEDIAL ALTERNATIVES FOR DEBRIS AND CONTAMINATED SURFACES

Criteria	Alternative CS-1 No Action	Alternative CS-2 Contaminated Surfaces Decontamination/ Off-Site Treatment and Disposal
Key Components	Restrict building access and use of buildings and equipment. Roof repairs to prevent leakage. Long-term inspection and maintenance program including five-year reviews to assess site conditions.	Decontaminate buildings and equipment via dusting, vacuuming and wiping and send dust for off-site treatment and disposal. Hydroblasting would be used to clean parts of building and this water would then be treated and disposed of with the standing water. Recyclable materials would be recycled.
1. <u>Overall Protection of Human Health and the Environment</u>	Provides protection to human health and the environment as long as the building is locked and its use is prohibited and there is no further significant deterioration.	Provides overall permanent protection to human health and environment.
2. <u>Compliance with ARARs</u>	Would not comply.	Would comply by removing and decontaminating contaminated surfaces and debris.
3. <u>Long-Term Effectiveness</u>		
o Magnitude of residual risks	Source would not be removed or treated, therefore residual risk remains. However, access would be restricted so that risks would be reduced.	No remaining risks after completion of remedial action.
o Adequacy of controls	The long-term maintenance program is designed to maintain the security of the building and is effective in minimizing trespassing.	The building decontamination and off-site treatment and disposal procedures are proven technologies.
o Reliability of Control	Building access control and security are reliable at minimizing access, although susceptible to vandalism.	All technologies are very reliable.
4. <u>Reduction of Toxicity, Mobility and Volume Through Treatment</u>		
o Treatment process and remedy	Locking building and roof repair would reduce mobility of contaminants. Toxicity and volume of contaminants remain unchanged.	Decontamination, off-site treatment and disposal are very effective at reducing toxicity, mobility and volume of contaminants in the buildings.

TABLE E-2

SUMMARY OF REMEDIAL ALTERNATIVES FOR DEBRIS AND CONTAMINATED SURFACES

Criteria	Alternative CS-1 No Action	Alternative CS-2 Contaminated Surfaces Decontamination/ Off-Site Treatment and Disposal
4. <u>Reduction of Toxicity, Mobility and Volume Through Treatment</u> (Con'td)		
o Amount of hazardous material destroyed or treated.	None by treatment.	All of the contaminated dust (approximately 70 cy) and debris (approximately 2,5000 cy) would be removed, treated and disposed of.
o Reduction of toxicity, mobility and volume (TMV).	Mobility is reduced by containing contaminants within building. Toxicity and volume of contaminants remains unchanged.	Toxicity, mobility and volume of building contaminants would be reduced.
o Irreversibility of treatment	No treatment. If building security is breached, exposure risks increase to current levels.	Treatment is irreversible.
o Type and quantity of treatment residues	No treatment involved.	No treatment residues remain.
5. <u>Short-Term Effectiveness</u>		
o Protection of community during remedial actions	No protection required.	Minimal risks due to increase in dust during remedial action. Safeguards would be implemented to minimize these risks.
o Protection of workers during remedial actions	Applicable OSHA regulations would be observed to prevent workers from normal construction hazards during roof repair.	Applicable OSHA regulations and personnel protective equipment would be used to protect workers during implementation of remedial actions.
o Environmental impacts	No environmental impacts from remedial actions.	No environmental impacts from remedial actions.
o Time until remedial response objectives are achieved	This alternative would not achieve the response objectives. It would take approximately 1 month to secure the buildings.	Time required to achieve response objectives is approximately 12 months. Actual remediation period is estimated to be 3 months.
6. <u>Implementability</u>		
<u>Technical Feasibility</u>		
o Ability to construct and operate technology	Sealing of building is easily implemented.	Dusting, vacuuming, wiping and hydroblasting technologies are easily implemented. Several off-site treatment and disposal facilities can handle the contaminated materials.
o Reliability of technology	Building access control and security techniques are reliable technologies. However, they could be breached by vandalism.	All technologies employed in this alternative are reliable.

TABLE E-2

SUMMARY OF REMEDIAL ALTERNATIVES FOR DEBRIS AND CONTAMINATED SURFACES

Criteria	Alternative CS-1 No Action	Alternative CS-2 Contaminated Surfaces Decontamination/ Off-Site Treatment and Disposal
6. Implementability		
<u>Technical Feasibility</u> (Cont'd)		
o Ease of undertaking additional remedial action, if necessary.	If monitoring indicates that future action is necessary, must go through the FS/ROD process again.	If additional contaminated surfaces are found during remedial action, they can be decontaminated at that time.
o Monitoring Considerations	Monitoring and 5-year reviews are required because contaminants remain on site.	No monitoring required after remedial actions are completed.
<u>Administrative Feasibility</u>		
o Coordination with other agencies	Coordination required with appropriate agencies for long time period for monitoring and reviewing site conditions.	Coordination required with DOT and local traffic authorities for transporting the contaminated dust to the off-site treatment and disposal facility.
<u>Availability of Services and Materials</u>		
o Availability of treatment, storage capacity and disposal services.	No treatment, storage or disposal facilities are required.	All of these services are available from several vendors.
o Availability of necessary equipment, specialists and materials.	Equipment and specialists for sealing building and for monitoring are readily available.	Equipment and specialists for performing the decontamination are readily available. Several RCRA-permitted facilities can accept the contaminated dust and water for off-site treatment and disposal.
o Availability of technologies	None required.	All technologies are proven and readily available from several sources.
7. Costs		
o Total Capital Cost (\$)	17,700	1,691,100
o Annual Operation and Maintenance (O&M) Cost (\$/yr)	6,800	0
o Present Worth* (\$ based on 5.0% discount rate and 30-year period)	136,100	1,691,100

* Present worth cost includes approximately \$5,000 for Alternative CS-1 for each five-year review and site assessment.

TABLE E-3

SUMMARY OF REMEDIAL ALTERNATIVES FOR STANDING WATER AND SEDIMENTS

Criteria	Alternative SW-1 No Action	Alternative SW-2 On-Site Treatment and Groundwater Recharge	Alternative SW-3 Off-Site Treatment and Disposal
Key Components	Long-term monitoring and 5-year reviews. Public awareness and education program.	Standing water and sediments would be collected and treated for metals removal via chemical precipitation, flocculation, and filtration. Ion exchange would be used, if necessary. The treated water would be recharged to groundwater via injection wells or infiltration basins. Drains would be decontaminated and unplugged.	Collection of standing water and sediments, and transport to a RCRA permitted treatment and disposal facility. Drains would be decontaminated and unplugged.
1. <u>Overall Protection of Human Health and the Environment</u>	Essentially no reduction in toxicity, mobility or volume of hazardous contaminants in the standing water. Risk from contaminant migration is monitored but not reduced. Does not meet the remedial objectives for the site and therefore does not provide protection to human health or the environment.	This alternative would remove and treat the contaminated water thereby eliminating all human health and environmental risks associated with the standing water, resulting in overall permanent protection to human health and the environment.	Same as Alternative SW-2
2. <u>Compliance with ARARs</u>	Would not comply. Would leave contaminated water and sediments on site.	Would comply because removes contaminated water and sediments and treats to discharge standards.	Would comply by removing contaminated water from the site.

TABLE E-3

SUMMARY OF REMEDIAL ALTERNATIVES FOR STANDING WATER AND SEDIMENTS

Criteria	Alternative SW-1 No Action	Alternative SW-2 On-Site Treatment and Groundwater Recharge	Alternative SW-3 Off-Site Treatment and Disposal
3. <u>Long-Term Effectiveness</u>			
o Magnitude of residual risks	Standing water and sediments would not be treated or removed. Existing risk will essentially remain. Natural attenuation is a very slow process.	No residual risks to public health or the environment remain after remedial action is completed.	Same as Alternative SW-2.
o Adequacy of controls	No remedial actions and therefore potential exposures remain the same.	These technologies are proven methods for handling these types of contaminants.	Same as Alternative SW-2.
o Reliability of Control	Monitoring program is reliable to assess contaminant migration.	These operations are reliable processes for handling the contaminated standing water and sediments.	Same as Alternative SW-2.
4. <u>Reduction of Toxicity, Mobility and Volume Through Treatment</u>			
o Treatment process and remedy	No treatment employed, conditions (toxicity, mobility and volume of contaminants) remain the same. Volume of contaminated standing water and sediments may increase.	Significant overall reduction in toxicity, mobility and volume of contaminants of concern in standing water and sediments.	Totally eliminates the toxicity, mobility and volume of all contaminants of concern in standing water and sediments at the site.
o Amount of hazardous material destroyed or treated.	None by treatment.	All standing water containing contaminants in excess of cleanup levels and approximately 200 cy of sediments underlying the standing water.	Same as Alternative SW-2.
o Reduction of toxicity, mobility and volume (TMV).	None by treatment.	Toxicity, mobility and volume of contaminated standing water significantly reduced.	Toxicity, mobility and volume of contaminated standing water at the site would be eliminated.

TABLE E-3

SUMMARY OF REMEDIAL ALTERNATIVES FOR STANDING WATER AND SEDIMENTS

Criteria	Alternative SW-1 No Action	Alternative SW-2 On-Site Treatment and Groundwater Recharge	Alternative SW-3 Off-Site Treatment and Disposal
4. <u>Reduction of Toxicity, Mobility and Volume Through Treatment</u> (Cont'd)			
o Irreversibility of treatment	No treatment involved.	Treatment is irreversible.	Same as Alternative SW-2.
o Type and quantity of treatment residues	No treatment involved.	Sludge would be generated and disposed of off-site. Total quantity of sludge and sediment is estimated to be 358 tons.	No treatment residue remains on site.
5. <u>Short-Term Effectiveness</u>			
o Protection of community during remedial actions	No short-term risks to community.	Minimal short-term risks	Same as Alternative SW-2.
o Protection of workers during remedial actions	No significant short-term risk. Personnel protection equipment would be used during sampling activities.	Applicable OSHA regulations, would be followed. Personnel protective equipment would be provided for workers.	No significant short-term risk. Personnel protective equipment would be provided to prevent direct contact with contaminated water and sediments.
o Environmental impacts	No short-term risks during implementation of this alternative.	No major environmental impacts during implementation of this remedial alternative.	Increased traffic and noise pollution resulting from hauling of contaminated water and sediments to off-site treatment facility. Possibility of spillage along the transport route.
o Time until remedial response objectives are achieved	Natural attenuation takes long period of time, over 30 years. It would take 3 months to implement the monitoring and institutional programs.	Overall remediation period is approximately 14 months. Actual remediation period is approximately 3 months.	Overall remediation period is approximately 6 months. Actual remediation period is approximately 3 months.

TABLE E-3

SUMMARY OF REMEDIAL ALTERNATIVES FOR STANDING WATER AND SEDIMENTS

Criteria	Alternative SW-1 No Action	Alternative SW-2 On-Site Treatment and Groundwater Recharge	Alternative SW-3 Off-Site Treatment and Disposal
6. Implementability			
<u>Technical Feasibility</u>			
o Ability to construct and operate technology	No construction involved. Monitoring program can be easily implemented.	Easy to construct and operate all aspects of this technology.	Availability of off-site treatment facilities may be potential problem.
o Reliability of technology	No treatment technology involved. Monitoring is reliable.	All aspects of this technology are very reliable.	Same as Alternative SW-2.
o Ease of undertaking additional remedial action, if necessary.	If monitoring indicates that future action is necessary, must go through the FS/ROD process again.	If found necessary, additional water could be treated using this facility.	Same as Alternative SW-2 assuming facility can handle additional volume of water.
o Monitoring Considerations	Long-term monitoring required. Migration/exposure pathways can be monitored.	No monitoring required after completion of remedial actions.	Same as Alternative SW-2.
<u>Administrative Feasibility</u>			
o Coordination with other agencies	Coordination required with appropriate agencies for long period for monitoring and reviewing site conditions.	Coordination required with EPA, DOT and State agencies during remedial actions.	Same as Alternative SW-2. In addition coordination required with local traffic authorities.
<u>Availability of Services and Materials</u>			
o Availability of treatment, storage capacity and disposal services.	No treatment, storage or disposal facilities required.	All of these technologies are proven and readily available.	All these technologies are proven, however facility availability may be limited.

TABLE E-3

SUMMARY OF REMEDIAL ALTERNATIVES FOR STANDING WATER AND SEDIMENTS

Criteria	Alternative SW-1 No Action	Alternative SW-2 On-Site Treatment and Groundwater Recharge	Alternative SW-3 Off-Site Treatment and Disposal
6. <u>Implementability</u> (Cont'd)			
o Availability of necessary equipment, specialists and materials.	Equipment and specialists for monitoring and implementing public awareness program are readily available locally.	Several vendors can provide all necessary equipment, specialists and materials.	Facility availability may be limited.
o Availability of technologies	None required.	Technologies are commercially available from several vendors.	Technologies are readily available. Facilities may be limited.
7. <u>Costs</u>			
o Total Capital Cost (\$)	0	1,335,000	993,200
o Annual operation and maintenance (O&M) cost (\$/yr)	10,700	0	0
o Present worth* (\$ based on 5.0% discount rate and 30 year period)	220,100	1,335,000	993,200

* Present worth cost includes approximately \$20,000 for Alternative SW-1 for each five-year review and site assessment.

1.0 INTRODUCTION

1.1 BACKGROUND

In 1989, EPA initiated a multi-phased removal action to mitigate risks to public health and the environment from on-site contaminant waste sources. The removal activities completed to date include securing the site and buildings to prevent further vandalism, temporary encapsulation of the four slag piles on site to reduce the migration of particulates via wind transport and surface runoff, reenforcement and berming of the slag areas, and removal of the most toxic and reactive materials from the property.

The purpose of the FFS is to identify and evaluate remedial alternatives for conducting an Early Remedial Action concerning several areas of hazardous surface contamination which would continue the site-stabilization effort initiated under the Removal Action. Problem areas of the site that require expedited attention, but were too complex and expensive as part of the removal activities, were addressed in this study. The three areas include: slag and lead oxide piles, debris and contaminated surfaces, and contaminated standing water.

Concurrent with the FFS, a Remedial Investigation and Feasibility Study (RI/FS) is being performed by O'Brien & Gere Engineers, Inc., a contractor hired by NL, which is a potentially responsible party for the site. This RI is a comprehensive study designed to determine the nature and extent of contamination on the site and areas adjacent to the site in various environmental media such as air, soils, groundwater, surface water and stream sediments. The FS will identify and evaluate remedial action alternatives to address contaminant sources and eliminate potential long-term health risks.

1.2 SITE LOCATION AND DESCRIPTION

1.2.1 Site Location and Description

The NL Industries, Inc. site is an abandoned secondary lead smelting facility situated on 44 acres of land on Pennsgrove-Pedricktown Road, Pedricktown, Salem County, New Jersey. The site is bisected by a railroad, with approximately 16 acres north of the tracks, which includes a closed 5.6-acre landfill. The southern 28 acres contain the industrial area and landfill access road (Figure 1-1). NL maintains the landfill area and operates the landfill's leachate collection system.

The site overlies the Cape May aquifer. The West and East Streams, which are intermittent tributaries to the Delaware River, border and receive surface discharges from the site. The nearest home is

less than 1000 feet from the site and B.F. Goodrich and the Tomah Division of Exxon are active neighboring industrial facilities.

1.2.2 Demography and Land Use

The 1980 U.S. Census reported that total population of Oldmans Township, in which Pedricktown is located, at 1,847. Oldmans Township had an average of 3.12 people per household with a median age of 31.

The site is part of an area that is zoned for development as an industrial park. This area includes operations of the following major corporations: Airco (inactive facility); B.F. Goodrich; Browning-Ferris Industries (inactive facility); and Exxon, Tomah Division. To the north of the industrial area, between the site and the Delaware River, is a military base and an Army Corps of Engineers Dredge Spoil area. The industrial park area is bordered by a combination of open, residential and agricultural lands. The residences are one or two story, single family homes. Agricultural lands produce a variety of crops, including tomatoes, corn, soybean, and asparagus.

1.3 SITE HISTORY

1.3.1 Historical Site Use

In 1972, the facility began the operation of recycling lead from spent automotive batteries. The batteries were drained of sulfuric acid, crushed, and then put through the lead recovery process at the on-site smelting facility. Plastic and rubber waste materials were buried in an on-site landfill.

Between 1973 and 1980, the New Jersey Department of Environmental Protection (NJDEP) cited NL with 46 violations of the state air and water regulations. Water pollution violations were directed toward the battery storage area and the on-site landfill. The NJDEP conducted an air monitoring program in 1980 that identified airborne quantities of lead, cadmium, antimony, and ferrous sulfate produced by the smelting process at levels exceeding the facility's operating permits.

NL ceased smelting operations in May 1982. In October 1982, NL entered into an Administrative Consent Order (ACO) with NJDEP to conduct a remedial program affecting the site soils, paved areas, surface water runoff, landfill, and groundwater. In December 1982 the site was placed on the National Priorities List (NPL).

In February 1983 the plant was sold to National Smelting of New Jersey (NSNJ) and smelting operations recommenced. NSNJ entered into an amended ACO with National Smelting and Refining Company, Inc. (NSR), NSNJ's parent company, NL and the NJDEP, which clarified environmental responsibilities of NSNJ and NL. NSNJ ceased

operation in January 1984, and filed for bankruptcy in March 1984. In June 1984, NL voluntarily entered the site to pump and dispose of leachate from the landfill.

In 1986, NL signed a consent order with EPA whereby NL assumed responsibility for conducting a site-wide Remedial Investigation and Feasibility Study (RI/FS) with EPA oversight. Versions of the RI Report were submitted to EPA in April and October 1990, and April 1991. EPA amended the report and approved it in July 1991.

TABLE 1-1
HISTORICAL SITE USE

COMPANY	ACTIVITIES	SUSPECTED WASTES
NL Industries Inc. (1972-1982)	Production of lead from used batteries.	Acids, heavy metals,
National Smelting of New Jersey (1983-1984)	Production of lead from used batteries and lead bearing materials.	Acids, heavy metals,

Removal Action Activities

EPA conducted a multi-phased Removal Action at the site to address several conditions that presented a risk to public health and the environment. EPA conducted Phase I of the Removal Action in March and April 1989 which consisted of construction of a chain-link fence to enclose the former smelting plant and spraying or encapsulation of the on-site slag piles. Encapsulation of the piles provided temporary protection from wind and rain erosion and contaminant migration.

In July and August of 1989, EPA sampled private potable wells located along U.S. Route 130, just north of the site, with the closest one being approximately 1000 feet from the landfill. The samples were analyzed for pH and heavy metals contaminants.

As part of the RI Phase I Sampling Program, an inventory of raw and waste materials was conducted at the site. The inventory revealed the storage of various hazardous chemicals, notably red phosphorus and metallic sodium, in a locked concrete storage building adjacent to the plant warehouse.

In November 1989, EPA began Phase Two of the Removal Action. This phase consisted of additional encapsulation of the slag piles,

securing the entrances of the contaminated buildings, and removal of over 40,000 pounds of the most toxic and reactive materials. The bulk of these materials were recycled and the remainder sent for disposal to a permitted landfill. These materials included arsenic, metallic sodium, red phosphorus and waste oil.

Chain-link fence gates were installed at all entrances of the contaminated buildings to deter trespassing. Moreover, the leaky roof of the lead oxide storage building was repaired to prevent the entrance of rainwater.

During 1989-1990, EPA's Technical Assistance Team (TAT) contractors conducted sampling and prepared a Removal Action/Feasibility Study (RA/FS) report to expedite surface cleanup of the site. This was a preliminary report which evaluated alternatives for the removal or treatment of the contaminated media, namely the slag piles, lead oxide piles and deteriorated drums; decontamination of buildings, equipment, paved surfaces and debris; and the treatment and disposal of contaminated, ponded stormwater.

Berms composed of sand and straw were installed around the perimeters of the slag piles to aid in containing the slag and to filter particulates in order to prevent their entry into surface runoff. In addition, the slag piles were treated with a second coating of the previously used encapsulant to help reduce further slag migration. In April of 1990, the concrete retaining walls around the slag piles were reenforced to prevent their collapse and release of slag to the environment.

During February and March of 1991, the slag piles, lead oxide pile and surface water at the site's former smelting facility were sampled as part of this FFS effort. This additional information was to be used to help evaluate appropriate remedial measures for treatment or disposal of these contaminated media.

During March of 1991, EPA performed Phase III of its removal activities at the site. During this phase, the damages to the perimeter fence were repaired and a new entrance gate was installed.

Approximately 2,200 empty, rusted and deteriorated 55-gallon steel drums were removed from the site for incineration and steel recycling.

All on-site containers, stored in the open, containing materials threatening release were emptied of their contents and piled under the existing covered area at the rear of the facility. Berms of a sand/gravel mix were installed at the base of the piles. These measures were taken to reduce the discharge of these substances as leachate or particulates.

Forty-four 55-gallon open head drums containing copper wire and

cable were removed from the facility and have been shipped to an EPA warehouse in Edison, New Jersey. This material and other items of value have been the main target of trespassers into the site. It was EPA's aim that this action would reduce or eliminate site break-ins, and subsequent exposure of individuals to hazardous materials would end as a result of this action.

The guard service that was implemented on November 17, 1990 as a result of the many entries and resultant thefts by intruders was discontinued as of March 29, 1991.

It should be noted that EPA has made several inquiries to parties that may have been interested in removing the slag for recycling. No positive responses were received, primarily due to the low lead content of the slag and lead oxide piles.

Current Conditions

The site is presently inactive. NL maintains the landfill area and its leachate collection system. The landfill operator and the New Jersey State Police continue to monitor the site. EPA has posted signs indicating that the site is hazardous and entry to the property is restricted. Figure 1-2 shows the location of the remaining on-site contaminant sources and debris. Table 1-2 (estimated), is a quantitative inventory of these materials.

1.4 ENVIRONMENTAL SETTING

1.4.1 Hydrogeologic Characteristics

The local aquifer system can be separated into three aquifers (unconfined, first confined and second confined) on the basis of ground water elevations and lithology around the site. The site geology consists of thick and interfingering strata of clay and sand. The clay members function as aquitards in some sections. The discontinuity of the Upper Clay member provides the potential for the unconfined aquifer to communicate with the first confined aquifer. The thickness of the Middle Clay Member observed appears to be greater than 20 feet thick, and its reported presence on adjacent industrial properties suggest that this aquitard extends across the site.

Groundwater flow in the unconfined aquifer is predominantly in a northwest direction, however, discontinuous layers of sands and clays cause localized variations in flow direction. Ground water in the first confined aquifer appears to flow in a westerly direction. Ground water flow in the second confined aquifer appears to be in a easterly direction. This suggests that the industrial supply wells neighboring the site may be controlling the second confined ground water flow under the site.

1.4.2 Climate

The climate of the site is largely continental, chiefly as a result of the predominance of winds from the interior of North America. Climatologic data for Salem County is collected by the New Jersey Department of Agriculture. The 1987 Annual Report states that Salem County receives an average of 42.81 inches of rainfall per year. The region experiences an average temperature of 55.2° F, with a monthly average low of 33° F occurring in January and a monthly average high of 77° F occurring in July. The wind rose for Philadelphia, PA airport indicates that over 50% of the wind over 3 miles/hour is from the west (north northwest to south southwest).

1.4.3 Soil

The soils under the NL site are characterized by a thin (1-2 inches) layer of top soil containing little plant material over a tannish-brown sandy soil. In adjacent wooded areas, a thick humus layer is overlaying the soil. This humus layer is generally six to eight inches thick. The soil under the humus layer is tannish to reddish brown. Soils on adjacent agricultural lands have twelve to fourteen inches of rich, blackish-brown topsoil with an underlying tannish-brown, sandy soil.

1.4.4 Drainage and Surface Water

An unnamed tributary to the Delaware River is located along the western property boundary, henceforth referred to as the West Stream in this report. A second stream, referred to as the East Stream, runs approximately 1000 feet east of and parallel to the Site's eastern property boundary. Both streams merge north of Route 130 and ultimately discharge to the Delaware River, which is approximately 1.5 miles from the site.

1.5 SITE RISKS / NATURE AND EXTENT OF THE PROBLEM

1.5.1 Sources of Contamination

The NL Industries, Inc. site was used during the approximate period from 1972 through 1984 for the production of lead from used batteries and other lead bearing materials. As a result, the site contains many potential sources of chemical contamination, numerous mechanisms for chemical migration, and many exposure pathways for both human and ecological receptors.

Numerous potential contamination sources of hazardous wastes were identified at the site during previous investigations conducted by EPA.

- Drums and debris were scattered throughout the site, inside and outside of buildings and on the paved areas. Some of this material is lead feed stock with high lead content. A

previous EPA removal action removed much of the reactive materials from the site.

- Approximately 200 cubic yards of lead oxide and similar materials, which are potential sources of lead and dust emissions, are stored in enclosed areas. Lead bearing materials are also present throughout the facility, specifically in piping, piles, conveyer and dust collection systems, and the process and ventilation equipment.
- Four separate piles contain an estimated volume of 9800 cubic yards of kiln slag from the smelting process, which could be a source of heavy metal and metal oxides contamination.
- Wipe samples indicate equipment surfaces and process building floor and wall contamination. Elevated levels of inorganics such as lead, cadmium and nickel were detected.
- Contaminated debris and drums of lead-bearing material, located throughout the site and buildings, have been consolidated into piles in semi-protected areas of the site during the last Removal Action.
- The buildings on the site contain many physical and environmental hazards, including water filled basements, areas filled with ponded water, hidden pits, and sumps containing contaminated liquids and sludges. Contaminated water is estimated at approximately 1 million gallons. Approximately 200 cubic yards of sediment were estimated to have accumulated in the standing water. Drains are blocked and contaminated liquid continues to accumulate and run off from the ponded areas.

Contaminants of concern and their concentrations are listed in Tables 3-1, 3-2, and 3-4.

1.5.2 Toxicity Information

High concentrations of lead, cadmium, nickel and other inorganics have been detected on site in the slag, standing water and dust. Lead exposure causes non-carcinogenic effects on the central nervous system. In addition, lead is considered a probable human carcinogen. Exposure to cadmium and nickel has been associated with non-carcinogenic effects via ingestion. Cadmium is a probable human carcinogen by inhalation based on evidence from human and animal studies. Nickel dust has an A classification and is carcinogenic by inhalation.

1.5.3 Contamination Exposure Pathways

In addition to the numerous contamination sources described above, the contaminants are believed to have migrated into the soil,

water, sediment and air since the plant began operation in 1972. Sampling of the soils, water and sediments has been undertaken by NL in connection with the RI/FS. These media will not be addressed in this FFS, except for the contaminated standing water in and around the process areas.

An exposure pathway consists of the following elements: (1) a source and mechanism of chemical release to the environment; (2) an environmental transport medium for the released chemical (e.g., air, surface runoff); (3) a point of potential human contact with the contaminated medium (referred to as an exposure point); and (4) a route of exposure at the exposure point (e.g., ingestion, inhalation, or dermal contact).

The plant-area sources of contamination have previously been identified as air-borne contamination and surface runoff resulting from the slag piles, other hazardous waste areas and standing water at the site. With the site sources (e.g. slag piles, standing water and dust) exhibiting some level of contamination there are many potential exposure scenarios. The following paragraphs address release mechanism, transport mechanism, potentially exposed populations and exposure routes relative to each of the potential exposure media - slag and lead oxide piles, debris and contaminated surfaces, and contaminated standing water.

1.5.4 Slag Piles and Lead Oxide Piles

When NL operated the facility, emissions from the plant discolored or stained aluminum siding of homes, automobiles, and etched concrete. High concentrations of lead, iron, cadmium, and antimony were detected in air-borne dust samples collected by NJDEP in 1980 when the plant was operational.

Four slag piles totaling approximately 9,800 cubic yards are stored on site in open, deteriorating bins and on paved ground surfaces. Consequently, the potential for erosion of dusts by wind is high. In addition, approximately 200 yards of lead oxide and similar materials are stored in enclosed areas. The slag materials were sprayed with an encapsulant to mitigate releases of hazardous constituents and contaminant migration which would occur from wind and rain erosion.

High concentrations of metals were detected in the slag and lead oxide piles. Concentrations of lead detected were as high as 130,000 mg/kg and 480,000 mg/kg in the slag and lead oxide piles, respectively. These concentrations exceeded the lead cleanup range of 500 to 1000 ppm listed in EPA's "Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund Sites." In addition, results of the Toxicity Characteristic Leachability Procedure (TCLP) results presented in Table 3-3 indicate that the majority of piles tested are hazardous based on leachability of lead and/or cadmium.

Based on the level of contamination detected in the slag and lead oxide piles, a qualitative risk assessment indicates that the potential for inhalation of contaminated dust is considered significant for on-site workers and nearby receptors. Runoff via rain erosion is a mechanism for potential release of contaminants into the environment. In addition, exposure via accidental ingestion, inhalation or through dermal contact is of potential concern for site workers and trespassers on the site.

1.5.5 Debris and Contaminated Surfaces

The process building walls, ceiling, floors, structural members, piping, and equipment are covered with dust. The results of wipe tests taken by EPA's TAT contractor in Table 3-1 indicate high concentrations of lead, iron, cadmium, nickel, and copper throughout the building. Concentrations of lead ranged from 0.88 to 552 micrograms/kg/quarter meter². Approximately 2500 cubic yards of contaminated debris consisting of lead dross and contaminated wooden pallets, baghouse bags, scrap metal and other materials are present throughout the site. Much of these materials were consolidated in temporarily protected areas as part of the most recent removal activity.

Releases of contaminants to air may occur from the migration of dust due to wind or activities at the site. The metal concentrations in the dust are significant and may pose a health risk, if inhaled by on-site workers or individuals downwind of the site. The potential also exists for site workers or trespassers and animals to be exposed to contaminated dust through dermal contact or ingestion, although the potential risk from this pathway is expected to be much lower when compared to the inhalation pathway.

1.5.6 Standing Water

It is suspected that the drains are blocked in areas where standing water is ponded. It was estimated that approximately one million gallons of contaminated standing water (i.e., accumulated rainwater) is present at the site. Samples of standing water collected by EPA's TAT contractor in November 1989 (Table 3-1) and March 1991 (Table 3-4), were found to have high concentrations of lead and other metals. Lead and cadmium concentrations were detected as high as 5,500 ppb and 560 ppb, respectively. The contamination is due, in part, to airborne particulates, and rain that has contacted the slag and lead oxide piles and other waste materials. In addition, approximately 200 cubic yards of sediments were estimated to have accumulated in the standing water.

Given site conditions, accidental ingestion and dermal contact are potentially the most likely on-site exposure pathways. The potential receptors would likely be site workers and area trespassers.

Off-site contaminant migration is potentially a significant exposure pathway from the NL site. During heavy rainfall, the standing water eventually overflows the site in the area of the West Stream. Concentrations of lead in the stream were measured as high as 206 ppb in surface water samples and 26,800 ppm in stream sediment samples taken in 1990. The lead concentrations in the stream exceed the EPA recommended surface water criterion of 1.3 ppb for protection of aquatic life due to chronic toxicity.

1.5.7 Conclusion

Concentrations of lead, specifically in the slag piles, exceed the lead cleanup level for Superfund sites of 500-1000 ppm listed in OSWER Directive #9355.4-02. In summary, current on- and off-site exposures resulting from hazardous materials present in the slag and lead oxide piles, contaminated surfaces and debris and standing water pose an imminent and substantial threat to public health and the environment.

1.6 Uncertainties

The procedures used to assess risks in this evaluation, as in all such assessments, are subject to a wide variety of uncertainties. Uncertainty in environmental sampling arises in part from the potentially uneven distribution of chemicals in the media sampled. Consequently, there is significant uncertainty as to the actual levels present. Environmental chemistry analysis error can stem from several sources including the errors inherent in the analytical methods and characteristics of the matrix being sampled. Uncertainties in the exposure assessment are related to estimates of how an individual would actually come in contact with the contaminants of concern.

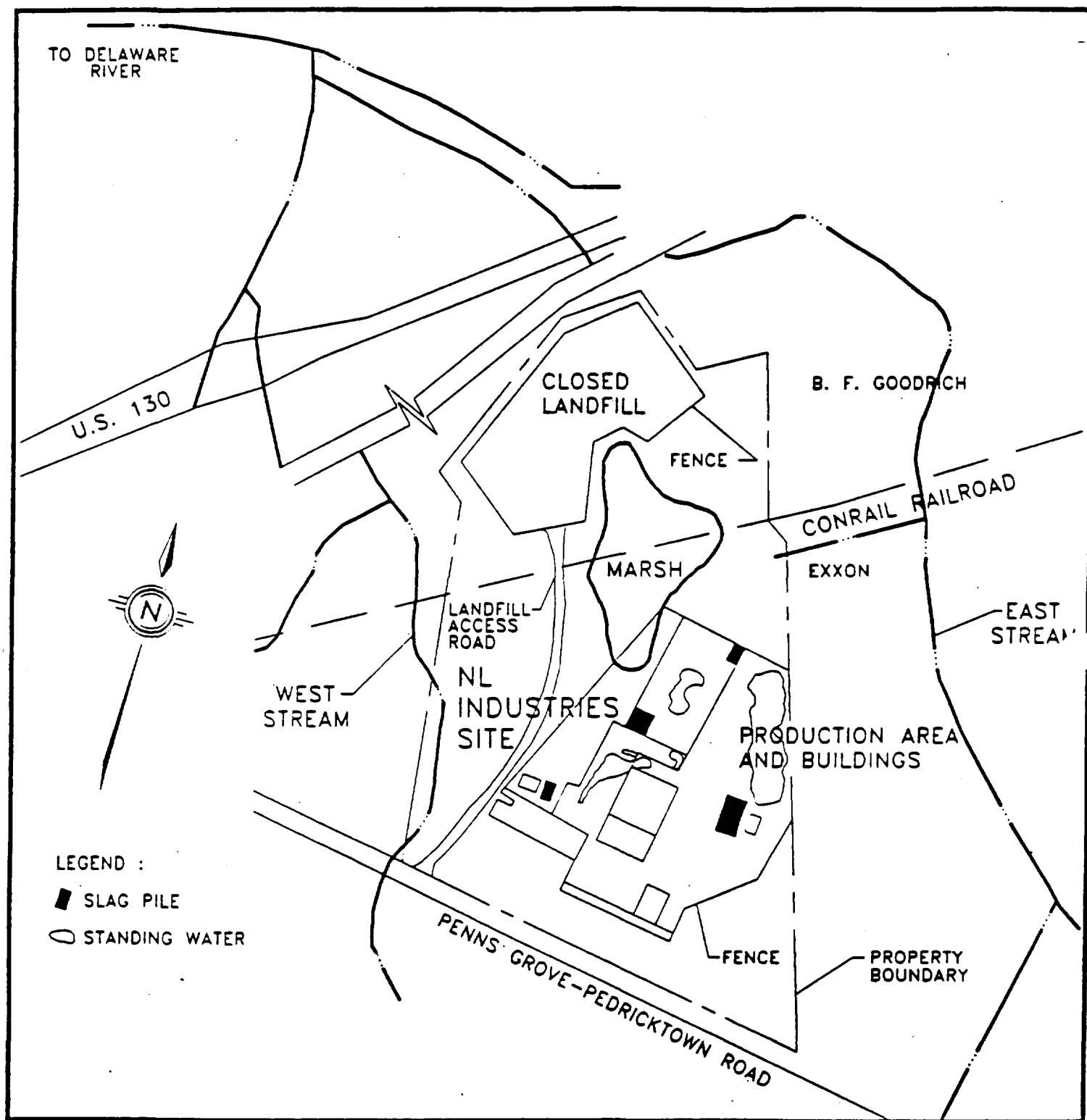
Actual or threatened releases of hazardous substances from this site may present a current or potential threat to the public health, welfare, and the environment.

TABLE 1-2 (1991)

NATIONAL LEAD
RELOCATED WASTE INVENTORY

<u>Sample #</u>	<u>Material</u>	<u>Estimated Volume</u>
1	Litharge	31 drums
2	Baghouse Socks	120 drums
2A	Baghouse Socks	160 CY
3	Paper Bags	50 CY
4	Fiber Drum Parts	200
5	Battery Casing & Debris	250 CY
6	Lead Bearing Slag	4 CY
7	Slag & Debris	170 CY
8	White Powder (Lead Sulfate)	110 CY
9	Lead Hard Head Material	40 CY
10	Lead Debris	400 CY
11	Red Dross	40 CY
12	Soft Lead Dross	105 CY
13	Black Dross	10 CY
14	Orange/Yellow Dross	4 CY
15	Empty Metal Drums	80
16	Wood Pallets	350
17	Drum Covers/Parts	60
18	Plastic Debris	60 CY
19	Rubber Conveyor Belts	60 CY
20	Lead Oxide	40 CY
21	Oily Sludge	(3) 55-Gal. Drums (4) 5-Gal. Pails
22	Liquids	(7) 55-Gal. Drums
23	White Powder	(300) Bottles
24	Standing Water	1 Million Gals.
A,B,C,D	Slag Piles	9,800 CY

CY=Cubic Yards



NOT TO SCALE

FIGURE 1-1

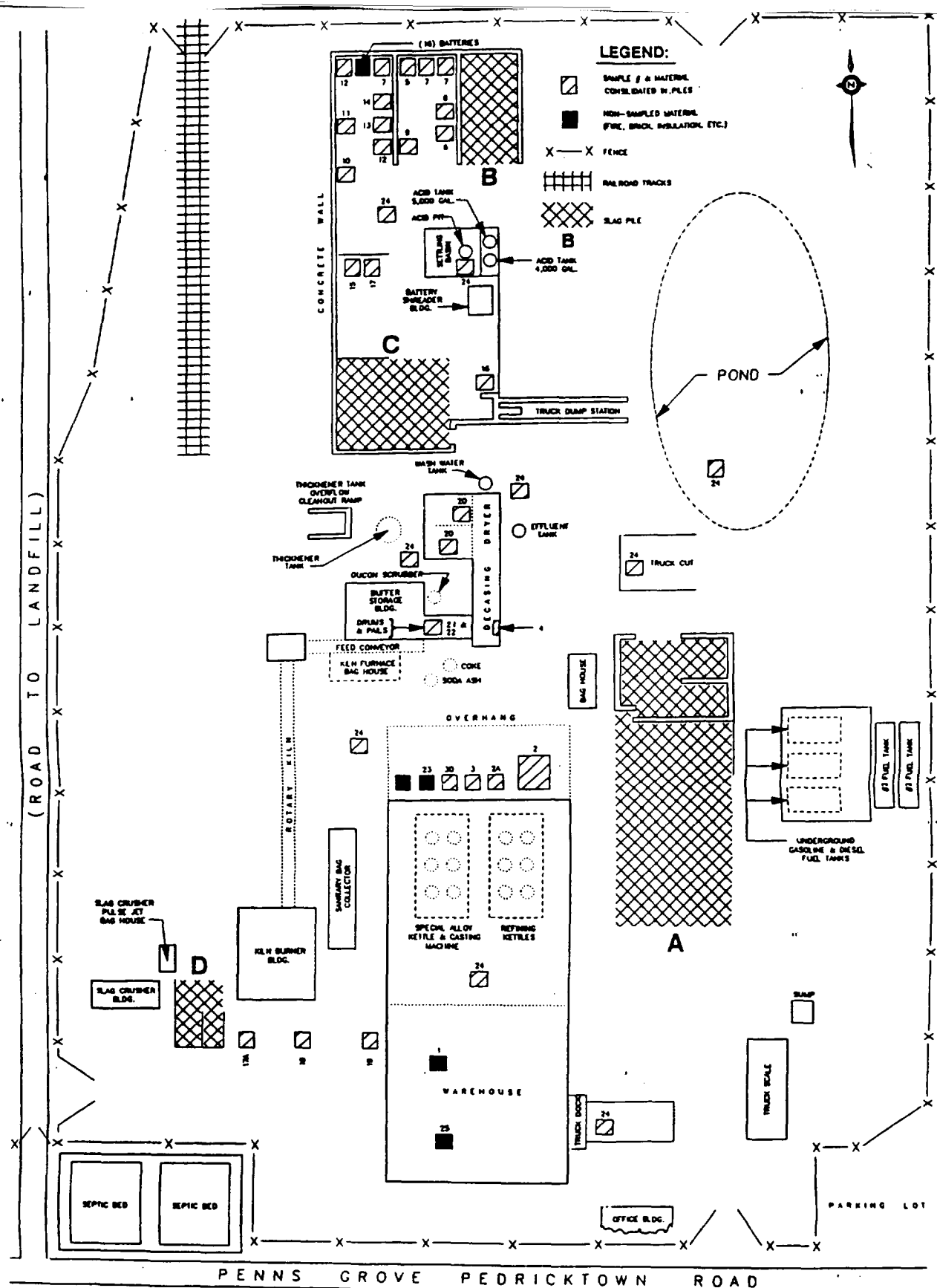


FIGURE 1-2
NL INDUSTRIES
 PEDRICKTOWN, NEW JERSEY
 OWN. NOT TO SCALE

2.0 JUSTIFICATION FOR EARLY REMEDIAL ACTION

Removal actions were performed from 1989 through 1991 to stabilize and secure the site. Major removal work was discontinued due to limited funds being available for removal of the slag, lead oxide, contaminated debris, contaminated water, and decontamination of equipment and surfaces.

Section 300.415 of the National Oil and Hazardous Substances Contingency Plan (NCP) describes the factors to be used in determining whether an Early Remedial Action is appropriate. An Early Remedial Action may be performed when the following conditions apply:

- [i] Actual or potential exposure to hazardous substances or pollutants or contaminants by nearby human populations, animals, or the food chain
- [ii] Actual or potential contamination of drinking water supplies or sensitive ecosystems
- [iii] Hazardous substances or pollutants or contaminants in drums, barrels, tanks, or other bulk storage containers that may pose a threat of release
- [iv] High levels of hazardous substances or pollutants or contaminants in soils largely at or near the surface that may migrate
- [v] Weather conditions that may cause hazardous substances or pollutants or contaminants to migrate or be released
- [vi] Threat of fire or explosion
- [vii] Other appropriate Federal or State response mechanisms to respond to the release are not available
- [viii] Other situations or factors that may pose threats to public health or welfare or the environment

An assessment of the conditions at the NL Industries, Inc. site with respect to the criteria described in Section 300.415 of the NCP yields the following conclusions:

- The presence of bulked storage piles containing hazardous substances satisfies criteria (i) and (iii).
- The presence of contaminated standing water on surfaces and in basements that may migrate off site satisfies criteria (i), (ii) and (iv).
- The presence of dust contaminated surfaces and debris satisfies criterion (i) and (v).
- The presence of a lead oxide pile and slag piles satisfies criteria (i), (iv), (v) and (vii).
- The presence of lead on the paved surfaces satisfies criterion (iv) and (v).

In addition, the need for Early Remedial Action is a direct result of the unique circumstances associated with thefts and vandalism at the site, which satisfies criterion (viii).

The Early Remedial Action is consistent with Section 104 of CERCLA, as amended, in that it will provide an orderly transition into, and will contribute to the efficient performance of the remedial action anticipated for this site.

3.0 FIELD INVESTIGATION FOR INTERIM ACTION

3.1 OBJECTIVES

The objectives of the field investigation for the Early Remedial Action were to identify and characterize the potential sources of contamination, and to gather data to evaluate remedial alternatives. Lead oxide, slag piles and standing water were sampled to determine the hazards posed by these materials present on site. In addition, extensive data were available as a result of the previous removal action and RI for the site.

3.2 AREAS OF CONCERN

3.2.1 Field Sampling Program

Field procedures for collecting samples and inventorying can be found in the Field Sampling and Analysis Plan. Summaries of the sampling activities for each of the study areas are provided below.

The investigation conducted by EPA in 1989 included the collection of 110 hazardous waste material samples and 7 water samples from 5 waste media (slag piles, lead oxide pile, other hazardous waste areas, process buildings, and standing water). The waste samples were analyzed for inorganic chemical constituents on the Hazardous Substances List (HSL).

During a second sampling effort in February and March 1991, the slag and lead oxide piles were analyzed using the Toxicity Characteristic Leaching Procedure (TCLP). Standing water was tested for inorganic chemical constituents on the HSL and for Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), and Total Suspended Solids (TSS).

Figures 1-2 and 3-1 show sampling locations, and Tables 3-1 through 3-6 summarize the analytical results of each waste stream. In addition to the contaminant concentrations of the slag and lead oxide, the physical/chemical properties of these materials would also be of importance in selecting a treatment process. Table 3-6 shows the pH, cation exchange capacity, grindability index and bulk density of the slag and lead oxide, while Figure 3-3 shows their grain size distribution. The sampling and analytical results for the waste streams are briefly discussed in the following subsections.

An inspection of the four site buildings was performed in March 1991 in order to evaluate their structural soundness to withstand decontamination by high pressure washing methods. Figure 3-2 shows the layout of the building area. The washing pressures to be employed range from 3500 to 350,000 KPa.

The definition of structural soundness for this investigation is:

1) the overall structural condition of the building and 2) the ability of the building's components to withstand the proposed pressure washing techniques for decontamination purposes.

The four buildings inspected were:

- 1) Warehouse/Refinery building
- 2) Kiln Burner and Feed building
- 3) Decasing building
- 4) Crusher building

An important site feature is that the drainage system at the site has been manually blocked causing the surrounding areas to become, and remain, flooded.

3.2.2 SUMMARY OF FIELD INVESTIGATION RESULTS

The results of the 1989 and 1991 field investigations are summarized in the following discussion. Tables containing analytical data are contained at the end of this chapter. An inventory of the remaining contaminated materials may be found in Table 1-2.

Slag Piles

Samples were obtained from the four slag piles designated A, B, C, and D. The concentrations of lead detected in the slag ranged from 8,950 to 252,000 mg/kg. The other inorganic HSL constituents were detected in all samples at lower concentration ranges. Most of the slag piles exceeded TCLP criteria for lead and/or cadmium, thereby characterizing the piles as hazardous.

Lead Oxide Piles

Samples obtained from this waste source were analyzed for HSL inorganics. The detected concentrations of lead ranged from 101,000 to 480,000 mg/kg. Cadmium, arsenic, aluminum, magnesium and antimony were also found at significant concentrations. The lead oxide piles exceeded TCLP criteria for lead and cadmium, thereby characterizing the piles as hazardous.

Other Hazardous Waste Areas

Fifty three (53) samples were collected from various other on-site waste sources. Lead concentrations measured in these areas ranged from 531 to 605,000 mg/kg. Other HSL inorganics were detected at concentrations approaching several orders of magnitude above those detected in the slag and lead oxide pile samples.

Process Building Wipe Samples

A total of 21 samples were obtained from the dryer, refining

kettles and casting machine located in the decasing building. The analytical results indicate relatively high concentrations of lead, iron, cadmium, nickel and copper. Concentrations of lead in wipe samples ranged from 0.88 to 552 micrograms/kg/quarter meter².

Standing Water

Samples were collected from five distinct on-site areas of standing water during the 1989 sampling event and from eight areas during the 1991 sampling event. The concentrations of lead and iron detected in the water ranged from 100 to 4,390 and 89 to 2,420 micrograms per liter, respectively. Magnesium and potassium were also found in moderately higher concentrations than the remaining metals detected.

3.3 STRUCTURAL INSPECTION

3.3.1 Warehouse/Refinery

The building referred to as the Warehouse/Refinery is composed of four parts: 1) the low ceiling warehouse in the southern portion of the building, 2) the warehouse in the central portion of the building, 3) the refinery also in the central portion, and 4) the patio in the northern portion of the building. Please note that the height to the ceiling in the warehouse, refinery, and patio are the same. Figure 3-2 shows the building areas.

The low ceiling warehouse is not separate from the warehouse. The warehouse is separated from the refinery by a steel panel partition wall. The refinery is also separated from the patio by a steel panel partition wall.

The Warehouse/Refinery is a steel frame building with steel panel roof and walls. The roof panels are insulated, the wall panels are not insulated. The low ceiling warehouse has block masonry walls. The foundations for the building's steel support columns were not visible. The floor is concrete. There is a flooded basement in the refinery area which was not entered and is not part of this evaluation.

The refinery area has three large ventilation units suspended from the roof frame. The suspension system for these units appears sound. The proposed pressure washing methods would not be suitable for these units. Additionally, the suspension system for the units must be evaluated for anticipated loads once a decontamination method is selected.

The patio area contains an exhaust tower consisting of a steel frame, stairs, walkways and flue. The structural condition of the tower is fair to poor. The frame appears sound, however the stairs and walkways are questionable.

The steel frame of the tower is of sufficient strength to withstand the pressure washing techniques. The walkways and stairs must be individually inspected for safety and strength.

The overall condition of the building is fair. It is structurally sound except that the roof of the patio has numerous leaks and pieces of the fiber insulation are loose. Portions of the roof may fall at any time and require attention before work is allowed in this area.

The lack of any maintenance of this building will cause the structural soundness to deteriorate. Roof leaks will increase the deterioration of the roof and wall panels as well as the steel frame. Additionally, the flooding around the building may lead to unforeseen foundation problems.

The floor and steel frame components of the building are all of sufficient strength to withstand the pressure washing techniques proposed for decontamination. The exterior and partition walls have sufficient strength to withstand the low range of washing pressures. The interior ceiling of the roof will not withstand the pressure washing techniques.

The ceiling is composed of a fiber insulation material (probably fiberglass) which is held in place against the roof by a wire mesh. The pressure washing would tear up the insulation.

3.3.2 Kiln Burner and Feed Building

The Kiln Burner building houses the rotary kiln. It is a steel frame building with walkways for access to the rotary kiln. The frame is covered with asbestos roof and wall panels and the bottom eight feet of the building is open with no walls. It is approximately three stories high. The foundation for the steel support columns was not visible.

The overall condition of the building is fair to poor. The steel frame is sound, however the walkways along the kiln are questionable. The roof and wall appear in fair condition, however there are a few roof leaks.

The lack of any maintenance of this building will cause the structural soundness to deteriorate as roof leaks increase the deterioration of the steel frame and walkways. Also, the flooding around the building may lead to unforeseen foundation problems.

The steel frame is of sufficient strength to withstand the pressure washing techniques. The stairs and walkways must be individually inspected for safety and strength. The walls and roof are asbestos panels and it is not advisable to pressure wash these components.

3.3.3 Decasing Building

The Decasing building is composed of a concrete floor, steel frame with steel panels, fiberglass panels, asbestos panels and plastic panels for walls and roof. Additionally, the building is several stories high (more than three stories) with stairs and walkways. The foundation for the steel support columns was not visible, however the columns on the north side of the building were encased in a concrete wall. The concrete wall was in poor condition.

The overall condition of the building is poor. The first floor is flooded with 6 inches of water. The steel frame which is visible appears sound. The portions which are encased in concrete may have been subjected to large lateral loads. The soundness of the stairways and walkways is questionable.

The concrete encased steel columns of the decasing building frame are portions of a concrete wall. The concrete wall may have been used as lateral support of an interior slag bin. All the slag bins at the site have concrete walls and all show signs of catastrophic failure of the bin walls. The steel support columns of the Decasing building may have undergone a similar loading which have caused all the other slag bin walls to fail.

The steel frame and floor are of sufficient strength to withstand the proposed pressure washing techniques. The walkways and stairs must be inspected individually for safety and strength. The wall and roof panels will not withstand the washing pressures.

3.3.4 Crusher Building

The Crusher building is two stories high. The building has a reinforced concrete first floor with an attached electrical control room constructed of masonry block. The upper portion of the building is a steel frame with steel panel walls and roof.

The overall condition of the building is fair. There is a broken section of the block masonry of the electrical control room. The break was caused by a pipe rack which was supported by the crusher building at one end and a slag bin wall at the other. The slag bin wall failed and pushed the pipe rack into the crusher building.

The entire crusher building and its components are of sufficient strength to withstand the proposed pressure washing techniques.

3.4 REMEDIAL ACTION OBJECTIVES

3.4.1 AREAS OF CONCERN

Early Remedial Action objectives were established for each of the areas (slag and lead oxide piles, debris and contaminated surfaces, and contaminated standing water and sediments) studied in this FFS.

The objectives have been established by considering the findings presented in the previous section of this report, the threats to public health and the environment associated with the hazards at the site, and any applicable or relevant and appropriate requirements of other Federal and State environmental laws and regulations.

An Early Remedial Action will be selected for the site based on this FFS. This action will continue the stabilization effort that began with the Removal Action. Remedial alternatives for a permanent cleanup of the soil and groundwater for the entire site are being evaluated in the RI/FS being conducted by NL Industries, Inc.

The remedial action objectives for each of the study areas are presented below. Each study area was considered separately. The problems associated with each of these areas are distinct from those associated with the other areas of the site. The discussions for the lead oxide and slag piles were combined because the remedial objectives for these areas of the site are similar. The debris and contaminated surfaces (dust) discussions were also combined because of the similarity of these two areas.

The remedial objectives are the basis for the development and evaluation of remedial alternatives. The development of remedial alternatives is presented in Section 4 of this document, and the detailed evaluation of remedial alternatives is presented in Section 5.

3.4.2 LEAD OXIDE AND SLAG PILES

Chemical analysis of samples of both the lead oxide and slag piles indicate that high levels of hazardous constituents are present. The contaminants of particular concern are heavy metals because of their prevalence, high concentrations, and high toxic or carcinogenic potency. These contaminants may be released into the environment by fugitive emission to the air of dust particles carrying the contaminants, surface runoff of contaminated solid material, or through leaching of contaminants from the solid material into surface water and groundwater. Another potential exposure route is direct contact. Evidence of trespassers and animals near both the lead oxide and slag piles has been observed.

As part of the previous Removal Action, the four individual piles of slag were sprayed with encapsulating material to provide temporary protection from wind and rain erosion and contaminant migration. However, this treatment eventually wore off after several months, due to crevices and pores constantly forming in the material. The slag and lead oxide piles remain contained, although they are located inside several above-ground decaying structures which may collapse. In fact, several of the bin's concrete restraining walls show evidence of cracking and early failure.

Release of the slag into the environment from these piles presents a significant risk to public health and the environment. Sampling results indicate concentrations well in excess of soil action levels.

The remedial objectives of the Early Remedial Action for the lead oxide and slag piles are to prevent further migration of the waste, to prevent direct human or animal contact or ingestion, and to prevent these piles from being a future source of contamination.

3.4.3 DEBRIS AND CONTAMINATED SURFACES

The debris and contaminated surfaces at the site pose several imminent hazards to public health and the environment. Much of the debris and contaminated surfaces would pose an immediate threat if runoff were to migrate offsite, in addition to being a hazard to trespassers and animals. Animal tracks and several dead birds have been observed in the contaminated areas. Trespassers at the site may come in contact with their remains.

The objective of the Early Remedial Action for the contaminated debris and surfaces is to eliminate these media as sources of future contamination and exposure, prevent contaminants from these media from leaking into the groundwater and surface water, and prevent human and animal contact with these contaminated media.

3.4.4 STANDING WATER

The ponded areas contain water contaminated with high levels of lead and other heavy metals. Any water that migrates off site would pose a serious threat to public health and the environment. The contaminated water poses an imminent threat to public health and the environment and should be addressed by the Early Remedial Action. As the water would eventually have to be decontaminated and removed from the site, addressing it during the Early Remedial Action is consistent with the overall remedy for the site. Since decontamination of the contaminated debris and surfaces may generate additional contaminated water, this media should be the last to be decontaminated. Finally, drains must be unblocked and decontaminated, which in conjunction with the decontamination of buildings and paved surfaces, would prevent contaminated runoff from leaving the site in the future.

The objective of the Early Remedial Action for the contaminated standing water is to eliminate this media as a source of future contamination and exposure at the site, prevent contaminants from this media from migrating into the groundwater and surface water, and prevent human or animal contact with, or ingestion of, this contaminated media.

TABLE 3-1 (1989)

SUMMARY OF CHEMICAL CONSTITUENTS IN DIFFERENT WASTE STREAMS
NL Industries, Pedricktown, New Jersey

HSL INORGANICS		SLAG PILE *				LEAD OXIDE *	OTHER WASTE *	DECONTAMINATION *	STANDING **
		A	B	C	D	PILE	AREA	BUILDING WIPE SAMPLES	WATER SAMPLES
CAS No.	PARAMETER	MIN - MAX	MIN - MAX	MIN - MAX	MIN - MAX	MIN - MAX	MIN - MAX	MIN - MAX	MIN - MAX
7429-90-3	Aluminum	2100 - 20000	1010 - 5100	5000 - 8200	2370 - 9000	575 - 1210	15.4 - 14000	0.024 - 32.7	50.7 - 622.4
7440-36-0	Antimony	67.7 - 3040	123 - 19000	500 - 3150	47.4 - 2100	1490 - 2790	1.1 - 144000	0.0004 - 56.2	33.0 - 2000.0
7440-38-2	Arsenic	116 - 3500	224 - 842	877 - 1300	170 - 2910	293 - 614	0.0 - 30000	0.0009 - 17.4	0.0 - 80.0
7440-39-3	Barium	12.0 - 1560	13 - 474	742 - 2590	301 - 2930	10 - 220	0.15 - 11000	0.014 - 1.4	37.0 - 66.0
7440-41-7	Beryllium	1.5 - 6.9	2.5 - 7.2	4.4 - 10	1.2 - 9.3	0.55 - 0.65	0.011 - 14.9	0.0007 - 0.036	3.0 - 3.0
7440-43-9	Cadmium	39.5 - 359	22.4 - 271	162 - 1460	42.4 - 549	205 - 650	0.97 - 11300	0.0012 - 3.7	11.0
7440-70-2	Celastum	1560 - 8520	2510 - 14100	6020 - 8950	4270 - 14100	1550 - 3150	13 - 146000	0.063 - 91.2	3790.0 - 25900.0
7440-47-3	Chromium	51 - 640	165 - 1150	342 - 1440	210 - 7240	140 - 151	0.95 - 20000	0.0024 - 4.6	0.0 - 14.1
7440-48-6	Cobalt	11.1 - 260	39.5 - 300	29.1 - 96.4	0.1 - 103	4.3 - 9.0	0.07 - 103	0.0049 - 0.13	0.0 - 217.0
7440-50-8	Copper	430 - 8590	1350 - 7110	1410 - 4060	400 - 3090	132 - 674	2.1 - 14900	0 - 17	21.9 - 770.0
7439-89-6	Iron	32000 - 167000	60000 - 106000	129000 - 264000	10000 - 254000	10500 - 20300	141 - 149000	0.46 - 677	89.4 - 2420.0
7439-92-1	Lead	13500 - 193000	49600 - 252010	85700 - 226000	8950 - 151000	101000 - 437000	531 - 463000	0.00 - 552	160.0 - 4390.0
7439-95-4	Magnesium	812 - 13500	516 - 5080	791 - 2590	854 - 10100	253 - 1020	3.5 - 13900	0.24 - 9.9	1120.0 - 5170.0
7439-96-5	Manganese	149 - 1610	64.3 - 920	935 - 2030	237 - 1640	60.1 - 210	0.96 - 3290	0 - 5.5	14.7 - 320.0
7439-97-6	Mercury	0.065 - 0.71	0.069 - 0.76	0.00 - 0.26	0.072 - 0.16	1 - 1.6	0.034 - 64	0.0001 - 0.019	0.2 - 4.5
7440-02-0	Nickel	84.0 - 1070	137 - 635	530 - 1190	112 - 2620	130 - 342	1.4 - 3700	0.0007 - 5.2	14.0 - 343.0
7440-09-7	Potassium	2650 - 68400	5360 - 61000	17500 - 46300	6530 - 63700	11200 - 44800	101 - 66000	0.073 - 70	3160.0 - 10000.0
7702-49-2	Selenium	0.03 - 2.4	0.03 - 1.1	1.1 - 1.3	0.01 - 1.5	0.73 - 0.86	0.007 - 43.5	0.0007 - 0.004	5.0 - 50.0
7440-22-4	Silver	2 - 0.5	3 - 12	6.9 - 11	2.4 - 15	2.7 - 0.9	0.12 - 95	0.0024 - 0.37	7.0 - 9.0
7440-23-5	Sodium	2370 - 67500	5140 - 63100	19700 - 40700	5930 - 65900	12000 - 40600	41.9 - 69400	0.3 - 77.9	3430 - 690000
7440-20-0	Thallium	0.03 - 3.7	0.9 - 1.1	1.1 - 2.7	0.01 - 1.5	0.0 - 0.86	7.4	0.0000 - 0.003	6.0 - 6.0
7440-62-2	Vanadium	96.4 - 653	295 - 460	569 - 1630	117 - 554	9.4 - 17.3	0.61 - 705	0.0049 - 0.35	12.0 - 20.4
7440-66-6	Zinc	567 - 6030	1700 - 8420	1270 - 5600	696 - 7430	404 - 1430	25 - 69600	0.036 - 204	72.0 - 7230.0
	Cyanide								

* UNITS - mg/kg

** UNITS - ug/liter

TABLE 3-2

Results of the Metals Analysis

SLAG AND LEAD OXIDE PILES (1991)

Concentration reported in mg/kg

Client #	808794	808795	808796	808797	808798	808799	
Location:	Lead	Lead	A Pile	B Pile	C Pile	D Pile	
	Oxide A	Oxide B					
% Solids	88.0	97.1	99.3	88.4	93.2	74.4	
Parameter:							DETECTION LIMIT
Aluminum	1400	800	94000	8700	11000	12000	50
Antimony	970	2500	12000	1100	400	300	1
Arsenic	400	690	1000	1600	1400	1200	1
Barium	770	40	800	650	1400	1300	2.5
Calcium	1000	800	300	50	350	260	2.5
Chromium	100	110	160	200	150	130	5
Copper	630	2400	31000	2750	2500	3060	5
Iron	12000	15000	130000	100000	110000	130000	10
Lead	480000	350000	130000	120000	130000	110000	50
Magnesium	780	860	19000	2000	1500	2040	5
Manganese	300	50	480	640	1100	1100	5
Mercury	2.10	2.60	0.02	0.10	0.02	ND	0.02
Nickel	380	630	640	890	470	800	5
Selenium	ND	ND	1	5	1	2	0.5
Silver	8	11	6	6	4	6	2.5
Zinc	1120	4000	40000	3500	3050	5570	2.5

ND denotes not detected

TABLE 3-3

Results of the Metals Analysis

of TCLP extracts

SLAG AND LEAD OXIDE PILES (1991)

Concentration reported in mg/L

Client #	C8794	C8795	C8796	C8797	C8798	C8799	Method	Regulatory Level
Location:	Lead Oxide A	Lead Oxide B	A Pile	B Pile	C Pile	D Pile	Detection Limit	
Parameters:								
Arsenic	ND	0.282	ND	ND	ND	ND	0.10	5.0
Barium	ND	0.199	ND	ND	ND	ND	0.10	100.0
Calcium	26.1	26.3	1.4	1.6	5.3	0.69	0.10	1.0
Chromium	ND	ND	ND	ND	ND	ND	0.10	5.0
Lead	620	2750	8.0	4.9	5.1	4.5	0.10	5.0
Mercury	ND	ND	ND	ND	ND	ND	0.10	0.2
Selenium	ND	ND	ND	ND	ND	ND	0.10	1.0
Silver	ND	ND	ND	ND	ND	ND	0.10	5.0

ND denotes not detected

TABLE 3-4
Results of the Metals Analysis
STANDING WATER SAMPLES (1991)

Client#	A	B	C	D	E	F	G	H	DETECTION
Location:	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	LIMIT
Unit:	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
Parameter:									
Antimony	28	100	21	27	29	340	28	5U	5
Arsenic	5U	5U	5U	5U	5U	5U	5U	5U	5
Beryllium	50U	50U	50U	50U	50U	50U	50U	50U	50
Cadmium	200	560	160	61	340	67	200	25U	25
Chromium	50U	50U	50U	50U	50U	50U	50U	50U	50
Copper	460	49	310	50U	50U	50U	450	50U	50
Lead	5500	1300	4500	1100	970	1100	5400	50U	50
Mercury	0.4U	0.4U	0.4U	0.4U	0.4U	0.4U	0.4U	0.4U	0.4
Nickel	180	100	140	50U	50U	50U	190	50U	50
Selenium	5	16	5U	5U	5U	23	5U	5U	5
Silver	25U	25U	25U	25U	25U	25U	25U	25U	25
Thallium	5U	5U	5U	5U	5U	5U	5U	5U	5
Zinc	3500	1400	2600	290	550	660	3500	25U	25

U - denotes detection limit

N/A - not available

TABLE 3-5 (1991)

Results of Total Suspended Solids, Biochemical Oxygen Demand, Chemical Oxygen Demand, and pH

STANDING WATER SAMPLES

Client# Location: Unit: Parameter:	E N/A mg/L	F N/A mg/L	G N/A mg/L	H N/A mg/L	DETECTION LIMIT mg/L
Total Suspended Solids	10U	10U	10U	10U	10
Biochemical Oxygen Demand	15U	15U	15U	15U	15
Chemical Oxygen Demand	10U	10U	10U	10U	10
pH **	6.67	8.14	6.46	8.66	+/- 0.1 *

U denotes that the given analysis was below the associated detection limit

N/A -Not available

* instrumental error

** pH is reported unitless

TABLE 3-6 (1991)

Table 1.3 Results of Hardgrove Grindability Index, Bulk Density
pH, and Cation Exchange Capacity

WA # 3476 National Lead Industries











Sample ID	Location	pH	Cation Exchange Capacity (meq/100g)
8794	Lead Oxide A	9.7	2.2
8795	Lead Oxide B	6.8	5.7
8796	Pile A	4.4	12.1
8797	Pile B	7.4	8.3
8797 Dup	Pile B	7.3	8.3
8798	Pile C	7.1	6.5
8799	Pile D	7.6	17.0

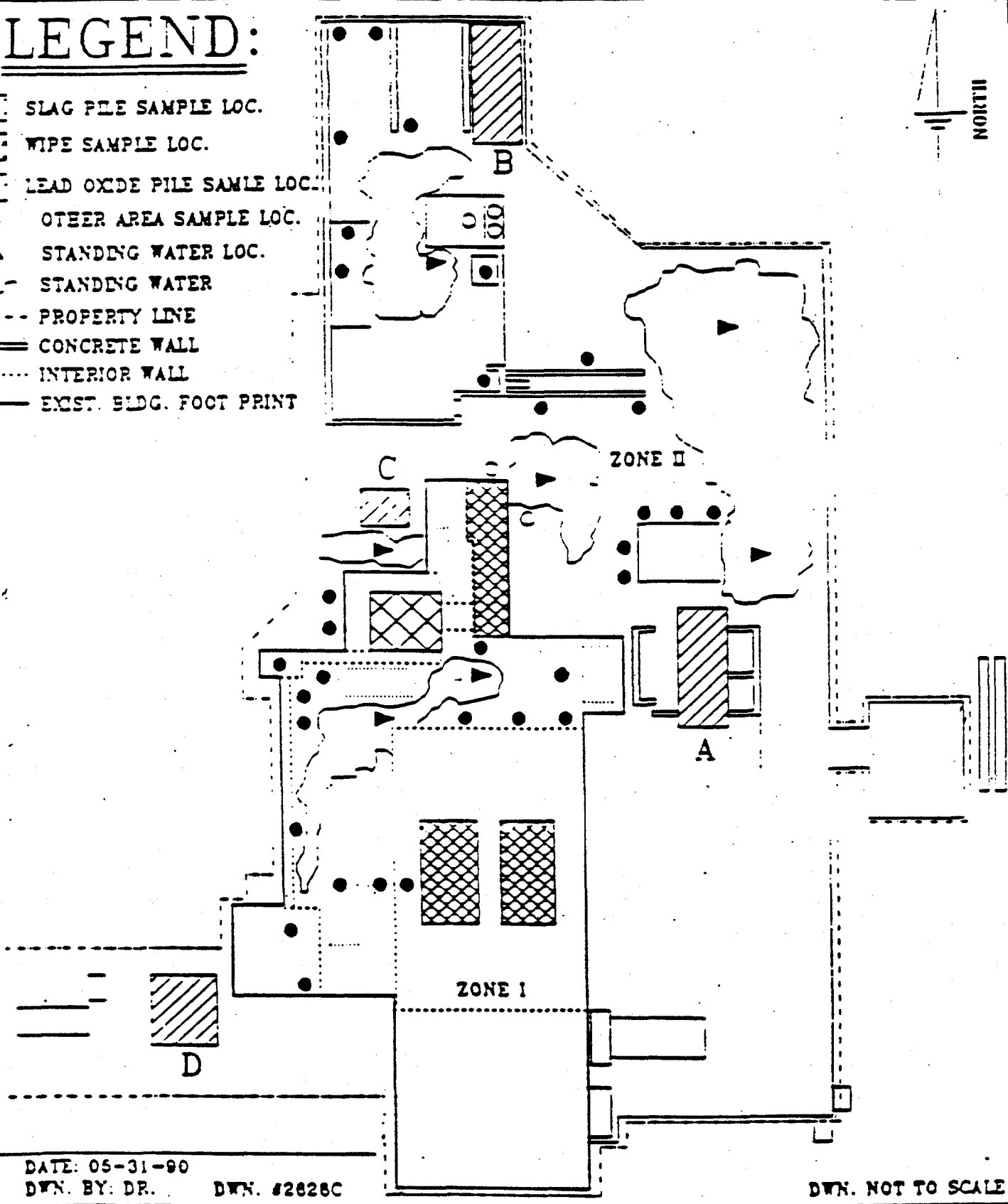
Sample ID	Location	Hardgrove Grindability Index	Bulk Density (mg/L)
8794	Lead Oxide A	109	3.31
8795	Lead Oxide B	122	3.02
8796	Pile A	103	2.44
8797	Pile B	108	2.22
8797 Dup	Pile B	109	2.26
8798	Pile C	121	2.35
8799	Pile D	122	2.47

. 00006

FIGURE 3-1 (1989) WASTE STREAMS AND SAMPLE LOCATIONS

LEGEND:

-  SLAG PILE SAMPLE LOC.
-  WIFE SAMPLE LOC.
-  LEAD OXIDE PILE SAMPLE LOC.
-  OTHER AREA SAMPLE LOC.
-  STANDING WATER LOC.
-  STANDING WATER
-  PROPERTY LINE
-  CONCRETE WALL
-  INTERIOR WALL
-  EXIST. BLDG. FOOT PRINT



DATE: 05-31-90

DWN. BY: DR.

DWN. #2628C

DWN. NOT TO SCALE

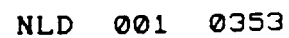
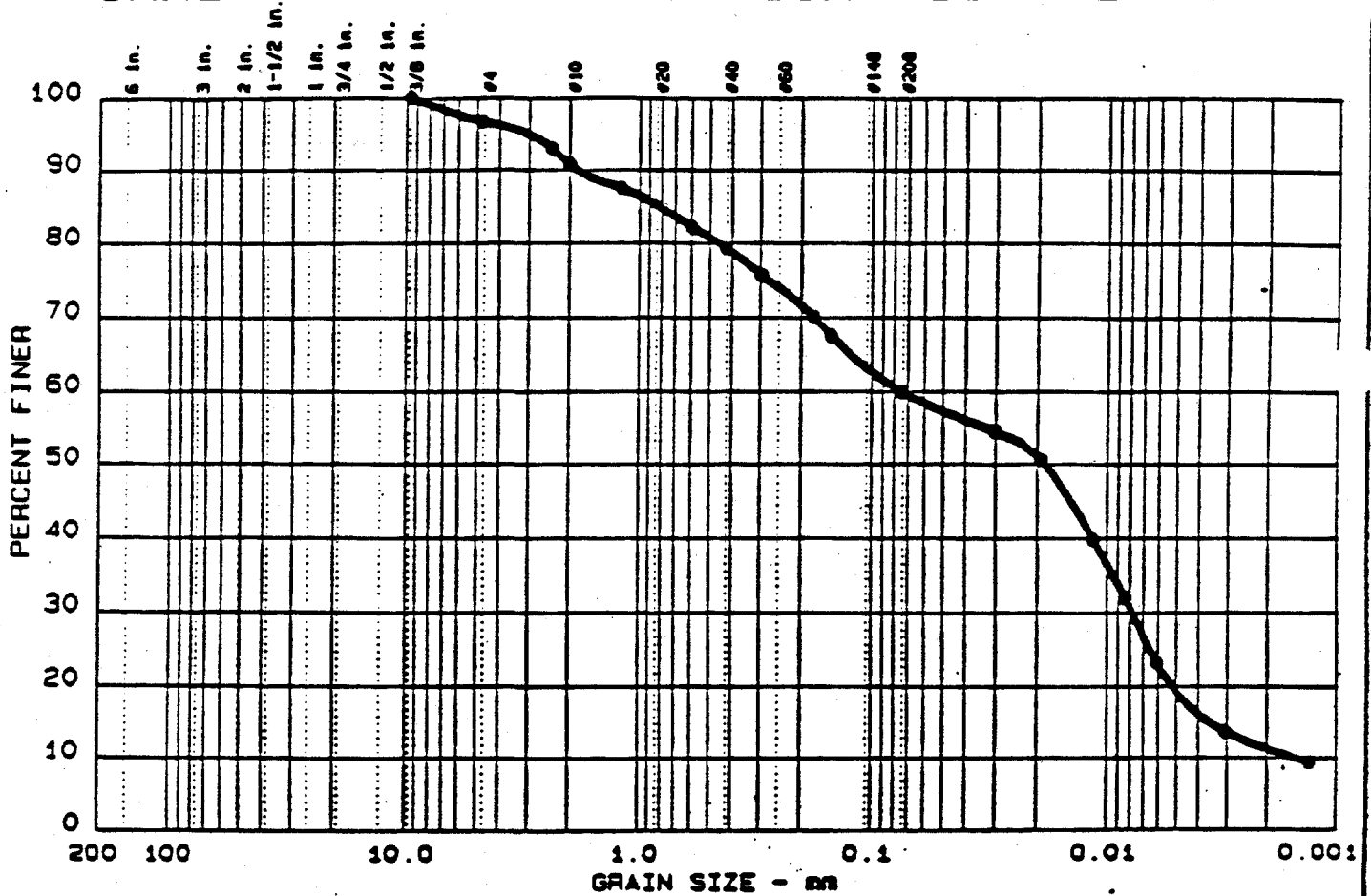


FIGURE 3-3 a

Pile A

National Lead Industries, WA # 3476

GRAIN SIZE DISTRIBUTION TEST REPORT

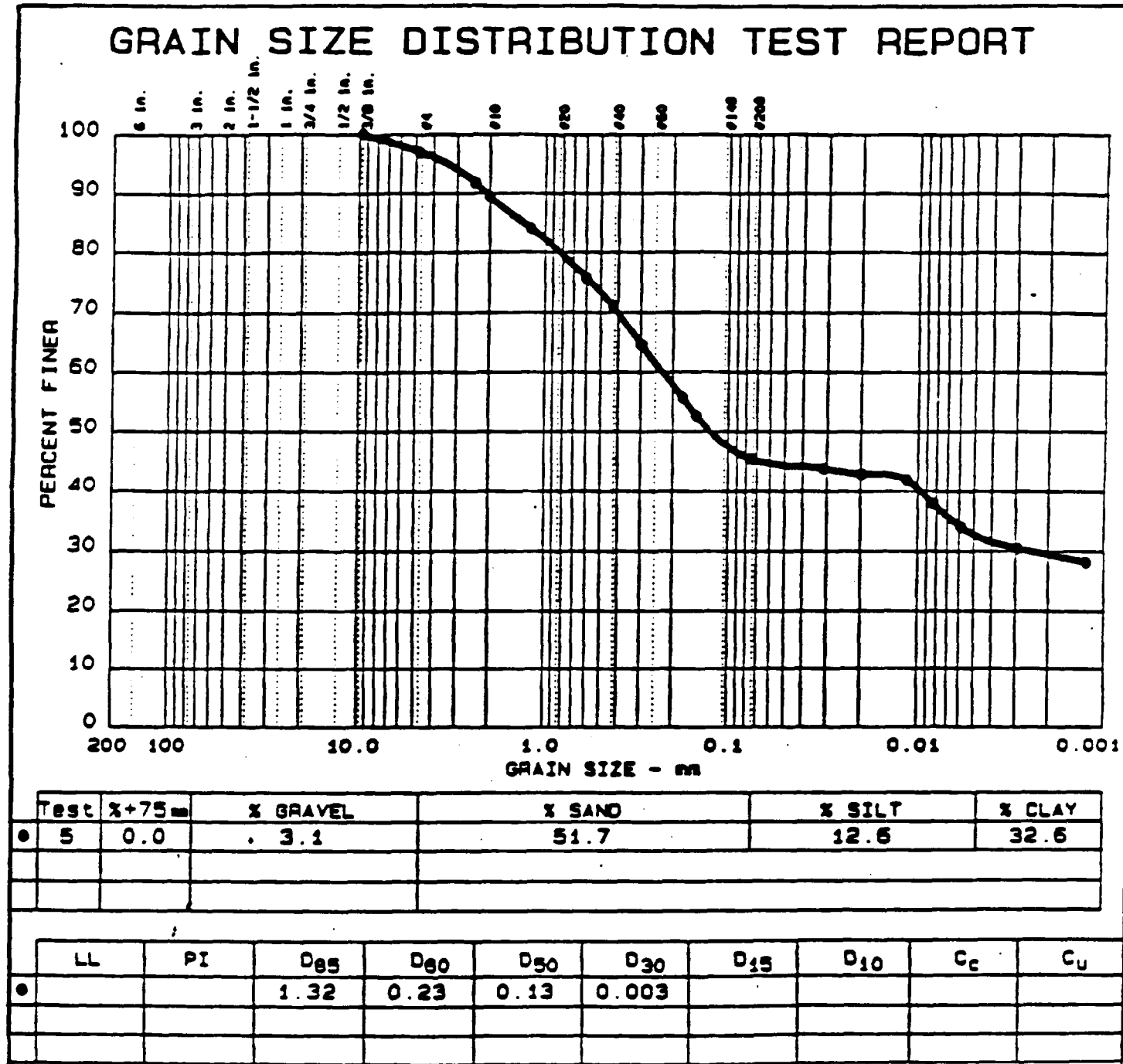


Test	%+75 _{mm}	% GRAVEL	% SAND	% SILT	% CLAY
• 4	0.0	3.4	36.8	40.7	19.1

LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
•		0.83	0.07	0.02	0.008	0.0036	0.0015	0.54	49.0

FIGURE 3-3 b

National Lead Industries, WA # 3476



00010

FIGURE 3-3 c

Pile C

National Lead Industries, WA # 3476

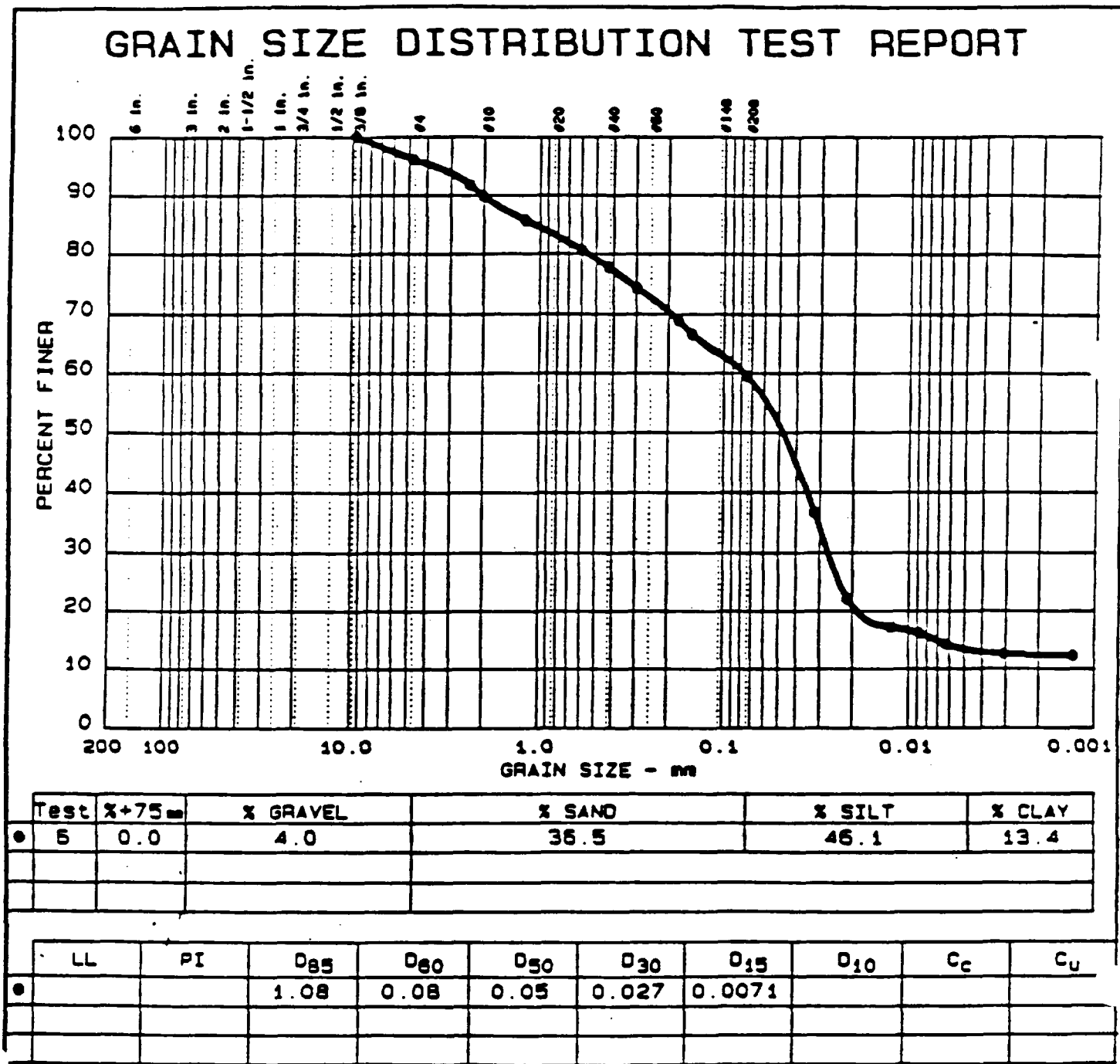


FIGURE 3-3 d

National Lead Industries, WA # 3476

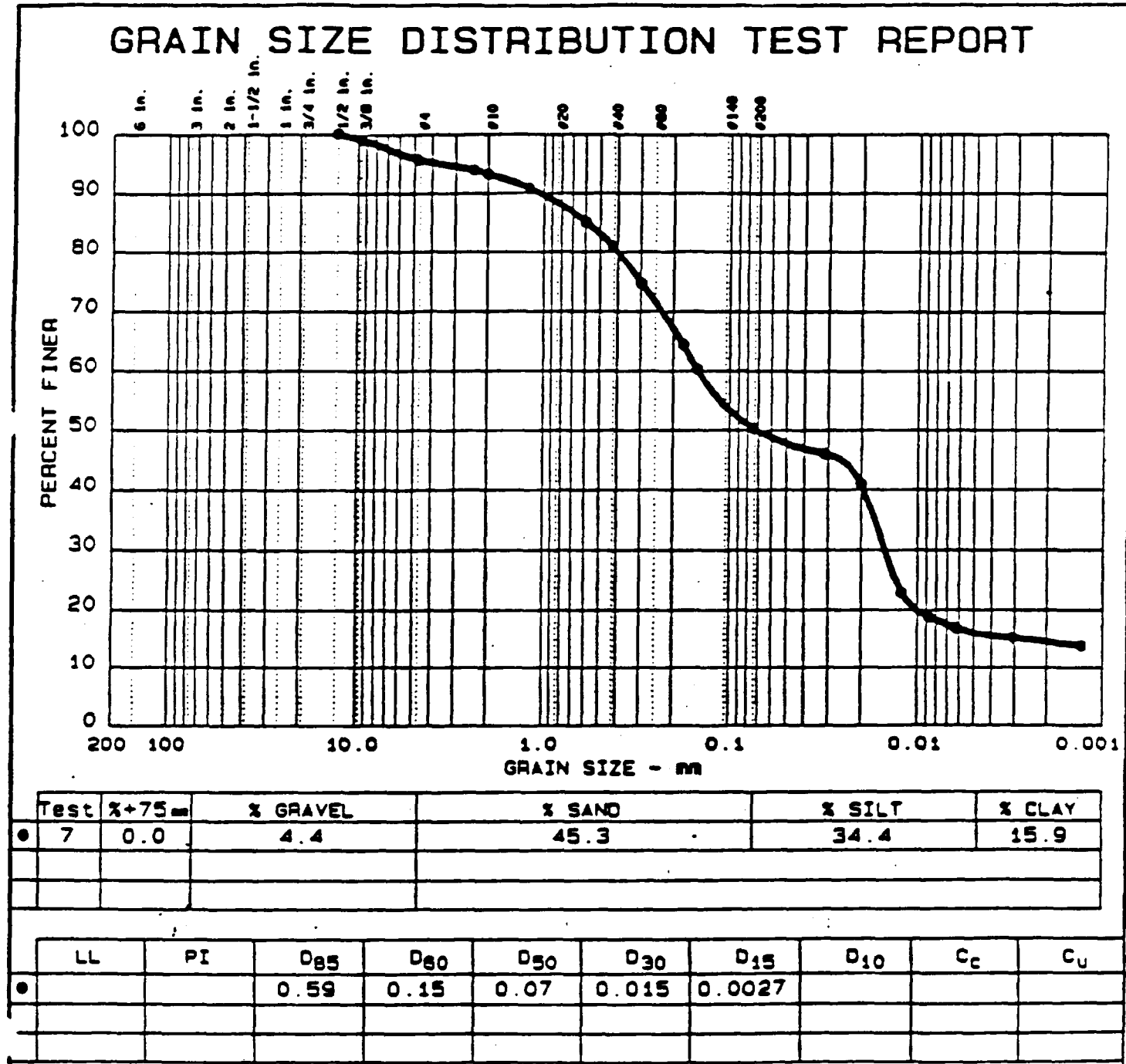
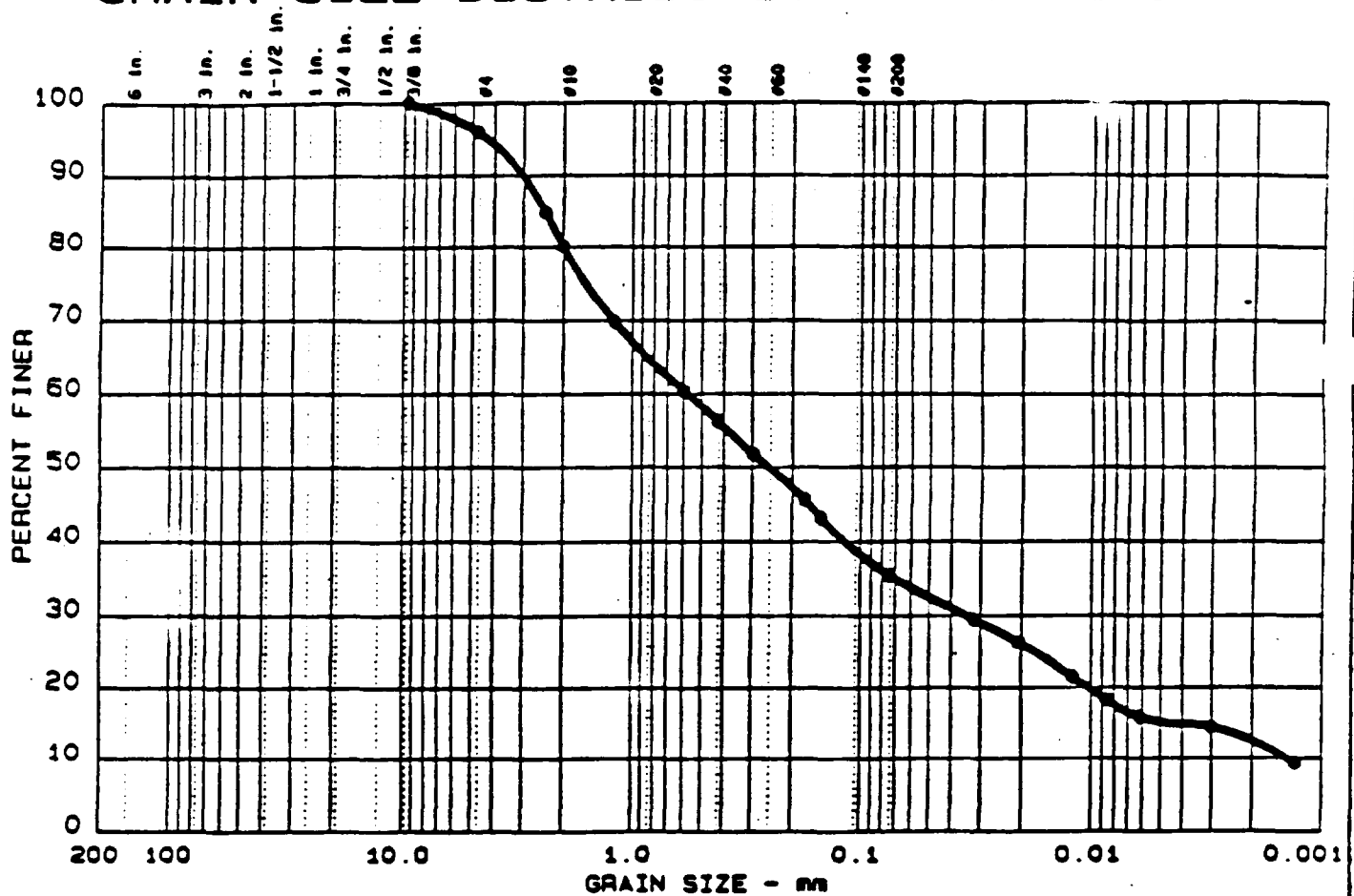


FIGURE 3-3 e

Lead Oxide A

National Lead Industries, WA # 3476

GRAIN SIZE DISTRIBUTION TEST REPORT

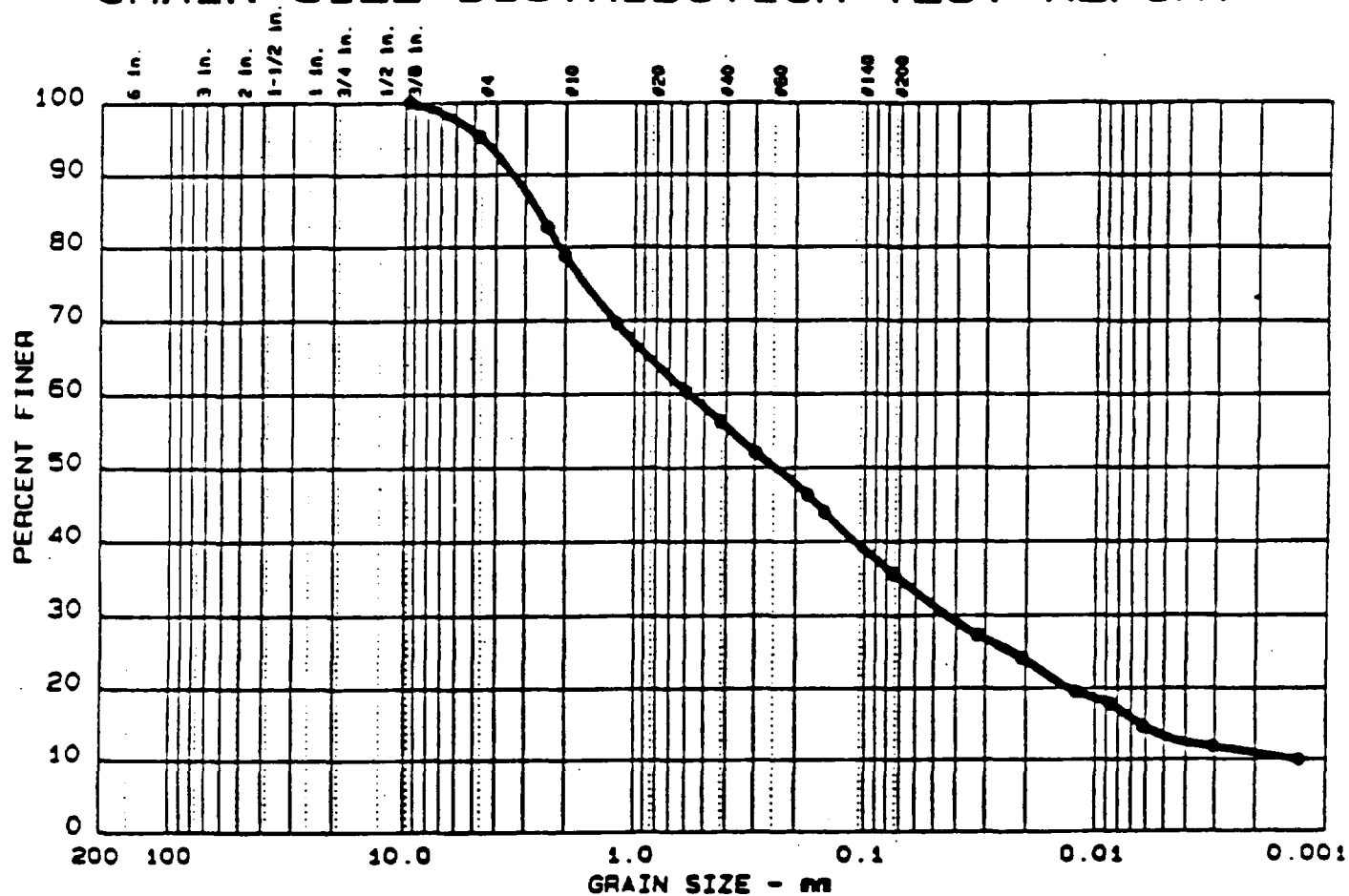


Test	%+75 _{mm}	% GRAVEL	% SAND			% SILT		% CLAY	
● 1	0.0	4.1	50.5			20.3		15.1	

LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
●		2.40	0.58	0.26	0.035	0.0043	0.0014	1.51	407.4

Lead Oxide B

GRAIN SIZE DISTRIBUTION TEST REPORT



Test	x+75	% GRAVEL	% SAND	% SILT	% CLAY
2	0.0	4.8	59.8	22.3	13.1

[illegible]

4.0 IDENTIFICATION AND SCREENING OF TECHNOLOGIES AND REMEDIAL ALTERNATIVES

4.1 IDENTIFICATION AND SCREENING OF TECHNOLOGIES

The purpose of this section is to present the development of remedial action objectives and to identify, screen, and select the most appropriate technologies to address contamination at the NL site. The most appropriate technologies or process options will be combined into remedial alternatives, to be addressed in Section 5.0.

The screening of technologies consists of five general steps which are discussed below:

1. Development of remedial action objectives specifying the contaminants and media of interest, exposure pathways, and preliminary remediation goals that permit a range of treatment alternatives to be developed. The preliminary remediation goals are developed on the basis of available chemical-specific ARARs, and site-specific, risk-related factors.
2. Development of general response actions for each medium, defining containment, removal, treatment, decontamination or other actions, singly or in combination, that may be taken to satisfy the remedial action objectives for the site.
3. Identification of volumes of slag and lead oxide piles, standing water, sediment, debris and contaminated surfaces to which general response actions might be applied, taking into account the requirements for protection of human health and the environment as identified in the remedial action objectives and the chemical and physical characterization of the site.
4. Identification and screening of the technologies applicable to each general response action in order to eliminate those that cannot be implemented technically at the site. The general response actions are further defined to specify remedial technology types (e.g., the general response action of treatment can be further defined to include physical, chemical, or thermal technology types).
5. Identification and evaluation of process options in order to select a representative process for each technology type retained for consideration. Although specific processes are selected for alternative development and evaluation, these processes are intended to represent the broader range of process options within a general technology type. Utilizing process options provides a greater flexibility in the final design, while simplifying the FS process. During the final design, any of the process option technologies can be substituted into a remedial alternative in place of another, thereby providing a broader range of viable alternatives.

This section is comprised of three subsections:

- 4.1.1 Remedial Action Objectives
- 4.1.2 General Response Actions
- 4.1.3 Identification and Screening of Technology Types and Process Options

4.1.1 Remedial Action Objectives

The remedial action objectives aimed at protecting human health and the environment will specify the contaminants of concern, exposure routes, receptors and acceptable contaminant levels.

4.1.1.1 Contaminants of Interest

As discussed in Section 1.5 of this report, numerous potential contamination sources of hazardous wastes were identified at the NL site during previous investigations conducted by EPA. These include: approximately 9,800 cubic yards (cy) of slag material in four separate piles, 200 cy of lead oxide material including lead bearing dross stored in the covered area in the rear of the building; and approximately one million gallons of standing water ponded throughout the site and basement of the refinery building. It is estimated that there is approximately 200 cy of sediment underlying the ponded water. There is debris scattered throughout the site. Volume of debris is estimated to be 2,500 cy consisting of empty drums, scrap metal, wood, plastic and rubber, paper, etc. Surfaces of process buildings, paved surfaces and equipment are also contaminated. The contaminated surface area is estimated to be approximately 40,000 square yards (sy). Generally all media of concern are contaminated with metals, principally consisting of lead, cadmium, nickel and copper.

4.1.1.2 Development of Remedial Action Objectives

Based on the review of available data, site characteristics, sources of contamination and the qualitative evaluation of the risk, significant health risks exist at the NL site due to inhalation, incidental ingestion and dermal contact of site slag and lead oxide materials and dust on contaminated surfaces. In addition, ingestion and dermal contact of contaminated standing water is a potential concern. Remedial action objectives addressing the human health risks and environmental concerns are presented in Sections 3.4.1 through 3.4.3.

4.1.2 General Response Actions

Using the objectives established in Sections 3.4.1 through 3.4.3 the potential general response actions were identified for the contaminated media at the site. To address the objectives developed for the contaminated media, No Action, treatment, and disposal actions are considered. No Action does not involve any treatment, but would implement the monitoring of contaminant migration (e.g., by monitoring wells and runoff sampling).

Treatment actions include treatment technologies that act to reduce the toxicity, mobility and/or volume of contaminants. These technologies include removal, pumping, treatment (physical, chemical or thermal, either off or on site), and decontamination technologies.

Disposal technologies include safe disposal of contaminated media and/or treated media along with secondary waste generated during the treatment. Disposal technologies may include either on-site or off-site disposal or a combination of both.

4.1.3 Identification and Screening of Technology Types and Process Options

The screening of remedial technologies is performed in two steps, the identification and screening of technology types and process options, and the evaluation and selection of representative process options.

4.1.3.1 Identification and Screening Criteria for Technologies

The remedial technology types associated with each of the general response actions typically considered for the cleanup of slag and lead oxide piles, standing water and debris and contaminated surfaces were developed from: National Oil and Hazardous Substances Pollution Contingency Plan (March 1990), Final Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (EPA, April 1989), the Technology Screening Guide for Treatment of CERCLA Soils and Sludges (EPA, September 1988), the Guide for Decontaminating Buildings, Structures and Equipment at Superfund Sites (EPA, March 1985), the Revised Handbook for Remedial Action at Waste Disposal Sites (EPA, October 1985), experience on other hazardous waste projects, knowledge of innovative technologies, and the professional judgment of the engineers performing the feasibility studies.

Remedial technology types associated with each response action for slag and lead oxide materials, debris and contaminated surfaces, and standing water and sediments are identified. Most of the remedial technology types contain several different process options that could apply to the contaminated slag and lead oxide materials, contaminated surfaces and standing water. These potentially applicable technology types and process options are identified and screened in this subsection. The screening of technology types and process options was based on technical implementability and effectiveness, considering the site-specific conditions, contaminant types and concentrations summarized in Section 1.0.

4.1.3.2 Evaluation and Selection Criteria for Representative Process Options

Process options for the technically feasible actions were evaluated prior to selecting a particular process option in order to represent each technology type. In some cases more

than one process option was selected for a technology type where data indicated sufficient differences in option performance. Process options were evaluated for effectiveness, implementability and cost for each process by itself, not for the site as a whole, as described below:

- o Evaluation of technology option effectiveness focused on:
1) effectiveness in handling the estimated quantities of slag and lead oxide material, contaminated surfaces and standing water and the ability to meet contaminant reduction goals; 2) effectiveness of protecting human health and the environment during the construction and implementation phases; and 3) reliability of the technology with respect to contaminants and site conditions.
- o The implementability evaluation consisted of an assessment of the technical and institutional feasibility of implementing a technology or process option. Since technical feasibility was used in the technology type screening evaluation, only institutional feasibility will be considered in this evaluation.
- o At this stage, cost evaluation is preliminary and estimates relied upon engineering judgment and vendor-provided information to provide a relative cost of process options within a technology type.

4.1.3.3 Screening and Evaluation of Slag and Lead Oxide Piles Remediation Technologies

In the following subsections, potential remedial technologies are briefly described and summarized with the results of the screening and evaluation. For those technologies which were not retained for further evaluation, the rationale for their elimination is included. The screening evaluations for each identified technology for slag and lead oxide piles are presented in Table 4-1. Evaluation and selection of process options are presented in Table 4-2.

4.1.3.3.1 No Action

No Action is not a category of technologies but types of actions undertaken when no remediation measures will be implemented. No Action may include monitoring and contaminant migration assessments.

TABLE 4-1

IDENTIFICATION AND INITIAL SCREENING OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS FOR SLAG AND LEAD OXIDE MATERIALS

GENERAL RESPONSE ACTION	TECHNOLOGY TYPE	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS
No Action	No Action	Monitoring, Public Awareness Program	No remedial action. Long-term monitoring and public awareness programs are implemented.	Potentially applicable. Provides baseline against which other remedial technologies can be compared. Required for consideration by CERCLA, as amended.
Waste Handling	Moving	Various earth moving technologies	Physical movement of waste materials using conventional earth moving equipment with intention of subsequent treatment and/or disposal.	Potentially applicable. Required component of all treatment and disposal remedial alternatives.
Treatment	Thermal	Vitrification	Vitrify slag and lead oxide material at high temperature until it melts and produce rigid glass like material.	Potentially applicable.
		Flame Reactor	The reactor processes waste with very hot reducing gas which results in a non-leachable slag and heavy metal-enriched oxide which could possibly be recycled.	Potentially applicable.
	Chemical	Washing/Extraction	Washing and extraction of inorganic contaminants from slag and lead oxide materials using acids, solvents, surfactants chelating agents etc.	Potentially applicable.
		Hydro-metallurgical Leaching	A hot, aqueous caustic solution is allowed to leach through the waste, extracting the metals. The solution can be regenerated.	Potentially applicable.

TABLE 4-1 (Cont'd)

IDENTIFICATION AND INITIAL SCREENING OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS FOR SLAG AND LEAD OXIDE MATERIALS

GENERAL RESPONSE ACTION	TECHNOLOGY TYPE	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS
Disposal	Hazardous Landfill	Stabilization/Solidification	Stabilization/solidification is a physical/chemical process whereby contaminated materials are converted into a stable cement type matrix in which contaminants are bound and become immobile.	Potentially applicable
		On-site Landfill	Treated or untreated material is disposed of in existing State permitted landfill on-site.	Not feasible since the existing landfill is closed.
		Off-site Landfill	Treated or untreated material would be hauled to an existing off-site landfill permitted to accept hazardous waste.	Potentially applicable for disposal of untreated and/or treated waste and secondary waste generated from treatment.
	Nonhazardous Disposal	On-Site Disposal	A Subtitle D nonhazardous landfill is constructed within the site boundary for disposal of treated slag and lead oxide material and other nonhazardous waste materials in accordance with RCRA treatment standards.	Potentially feasible if treated waste passes TCLP test and considered as nonhazardous.
		Off-Site Disposal	Treated slag and lead oxide material would be hauled to an existing subtitle D nonhazardous landfill.	Potentially applicable.

TABLE 4-2

EVALUATION OF REMEDIAL TECHNOLOGIES FOR SLAG AND LEAD OXIDE MATERIALS

GENERAL RESPONSE ACTION	TECHNOLOGY TYPE/ PROCESS OPTION(S)	EFFECTIVENESS	IMPLEMENTABILITY	COST	STATUS
No Action	No Action Monitoring, Public Awareness Program	<ul style="list-style-type: none"> - Does not reduce toxicity, mobility or volume (TMV) - May provide limited reduction of risk of direct contact with contaminated slag and lead oxide piles - Reliability is dependent on future maintenance and enforcement 	<ul style="list-style-type: none"> - Easily implemented - Routinely used - Periodic inspection and maintenance required - Enforcement may be difficult 	Low	Retained for further consideration, as required by CERCLA, as amended
Waste Handling	Moving: Various earth moving technologies	<ul style="list-style-type: none"> - Effective at moving contaminated material - Required for subsequent treatment/disposal 	<ul style="list-style-type: none"> - Technically feasible - Can be done using common earth moving equipment - May require dust suppression during handling 	Low	Retained for further consideration as a support technology to be used with other technologies
Treatment	Thermal Treatment: - Vitrification	<ul style="list-style-type: none"> - Binds non-volatile metals in glass-like mass - Not effective in binding-volatile metals - Reduction in volume and mobility of non volatile metals. Toxicity reduced to some extent 	<ul style="list-style-type: none"> - Commercial mobile treatment system available - High power requirement - May need special power connections - Requires complex air pollution control equipment 	High	Retained for further consideration because effective for nonvolatile metals
	- Flame Reactor	<ul style="list-style-type: none"> - Binds non-volatile metals in slag mass which can be recycled as fill material or road aggregate - Reduction in volume of treated material 	<ul style="list-style-type: none"> - Stationary or mobile commercial units not available at present but would be available in near future - Pilot tests may be required 	Moderate	Retained for further consideration
	Chemical Treatment: - Washing/Extraction	<ul style="list-style-type: none"> - Reduction in toxicity, mobility and volume of contaminants - Multiple contaminants may require multiple extraction process 	<ul style="list-style-type: none"> - Commercially available but limited supply of units - Pilot tests required 	High	Eliminated from further consideration due to multiple contaminants, high cost and limited experience
	- Hydro-metallurgical Leaching	<ul style="list-style-type: none"> - Reduction in toxicity, mobility and volume of contaminants - Lead may be recovered from leach solution 	<ul style="list-style-type: none"> - Commonly used for extraction of metals from ores - Commercially available but would require process modifications to treat CERCLA waste 	Moderate	Retained for further consideration

TABLE 4-2 (Cont'd)
EVALUATION OF REMEDIAL TECHNOLOGIES FOR SLAG AND LEAD OXIDE MATERIALS

GENERAL RESPONSE ACTION	TECHNOLOGY TYPE/ PROCESS OPTION(S)	EFFECTIVENESS	IMPLEMENTABILITY	COST	STATUS
Disposal	- Stabilization/ Solidification	<ul style="list-style-type: none"> - Effective in stabilizing metals - Reduces mobility but does not reduce toxicity or volume - Bench-scale test required to evaluate reduction in mobility 	<ul style="list-style-type: none"> - Volume of stabilized material may increase up to 40% because of the addition of stabilizing agents - Easy to implement 	Low	Retained for further evaluation
	Hazardous Landfill: - Off-Site Hazardous Landfill	<ul style="list-style-type: none"> - Effective in reducing risks posed by slag and lead oxide materials - Would contribute to the protection of public health and the environment by reducing exposure to on-site contaminants - Volume or toxicity of treated waste is not decreased but mobility is controlled 	<ul style="list-style-type: none"> - Limited off-site landfills in the area - Land disposal restrictions may make implementation difficult - Technically easy to implement 	High	Retained for further evaluation
	Nonhazardous Disposal: - On-Site Disposal	<ul style="list-style-type: none"> - Does not require transportation of treated material 	<ul style="list-style-type: none"> - Easily implemented - Sufficient space available 	Low	Retained for further evaluation
	- Off-Site Disposal	<ul style="list-style-type: none"> - Removes the material from site - Reduces toxicity, mobility and volume at the site 	<ul style="list-style-type: none"> - Difficult to find landfills willing to accept treated hazardous waste - Technically easy to implement 	Moderate	Retained for further evaluation

o No Action

Description: No Action is not a category of technologies and no remediation measures will be implemented. However, the No Action approach includes monitoring groundwater and surface water, and periodically assessing contaminant migration from slag and lead oxide piles into groundwater and surface water. The No Action alternative will be considered in this report as required by Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) as amended, when no remedial measures will be taken to reduce the risk of further contamination or other health hazards.

Initial Screening: No Action would not meet remedial objectives for the site. However, it is retained (Tables 4-1 and 4-2) through the detailed evaluation as a baseline comparison with other alternatives for slag and lead oxide piles.

4.1.3.3.2 Waste Handling

Hazardous waste handling involves physically moving the hazardous waste materials.

o Moving

Description: Physically moving the waste material, usually with the intention of subsequent treatment and/or disposal. The materials would be managed in such a way as to minimize or prevent their future contact with public and the environment. Conventional earthwork equipment (e.g. backhoe, front-end loader, bulldozer) could be used for moving.

Initial Screening: This would be required as the initial material handling step for the slag and lead oxide materials. One or more types of earthwork equipment would be used for slag and lead oxide handling. Moving technology is therefore retained for further consideration (Tables 4-1 and 4-2).

4.1.3.3.3 Treatment

Treatment technologies are used to change the physical and/or chemical state of a contaminant in order to destroy the contaminant completely, reduce toxicity, mobility and/or volume of the contaminants present at this site. The treatment technologies considered are thermal treatment, physical treatment and chemical treatment. Most of these technologies can be implemented at the site or at off-site treatment and disposal facilities.

Thermal Treatment

Thermal treatment is a technology category which utilizes thermal energy under controlled conditions to treat contaminated slag

and lead oxide materials to reduce the volume, toxicity or mobility of contaminants. The process options included in this technology category are vitrification and flame reactor.

o Vitrification

Description: Vitrification is used to transform chemical and physical characteristics of hazardous waste such that the treated residues contain hazardous material immobilized in a vitreous mass. The destruction of the hazardous organic waste is achieved in a reaction chamber in which high temperature is used to reduce toxic organic compounds to elemental gas (CO , H_2) and carbon. Inorganic contaminants should remain entrained in the glass and siliceous melts. The advantages of vitrification over other thermal processes are the lack of oxidation products and large air emissions, and the reduced leachability of inorganic materials, such as heavy metals.

Initial Screening: Vitrification is best suited for hazardous waste consisting of both organic and inorganic material. Metals such as ferrous iron, chromium, nickel and mercury are a problem. Volatile metals like arsenic, lead and mercury would be volatilized and may not be entrained in molten slag. This may require incorporation of complex air pollution control equipments. This technology is however retained for further consideration due to its potential for immobilizing most of the metals (Tables 4-1 and 4-2).

o Flame Reactor

Description: The Flame Reactor is a patented process primarily designed to treat wastes containing metals and/or organics. In the reactor, wastes are subjected to a very hot reducing gas (greater than $2,000^\circ\text{C}$) produced from the combustion of solid or gaseous hydrocarbon fuels in oxygen-enriched air. In the reactor, the waste materials react rapidly, producing a non-leachable slag (resembling glass when cooled) and a recyclable, metal-enriched oxide. The volume of waste reduced to slag depends on the chemical and physical properties of the waste. In general, the process requires that waste be dry enough (up to 15% total moisture) to be gravity-fed and fine enough (less than 200 mesh). Larger particles (up to 20 mesh) can be processed; however, a decrease in the efficiency of metal recovery usually results. A hammer mill or other equipment may be required at the front end for particle size reduction.

Initial Screening: The Flame Reactor technology can be applied to granular solids, soil, flue dust, slag, and sludge containing heavy metals. Slag and lead oxide material at the NL site contain high concentration of lead, iron, zinc, copper and

cadmium. Flame Reactor technology can be used to produce metal enriched oxide and non-leachable slag, which may possibly be recycled as fill material or road aggregate. This technology is therefore retained for further consideration (Tables 4-1 and 4-2).

Chemical Treatment

Chemical treatment is a category of technologies which utilize chemical reactions or changes of chemical properties in treating contaminants to reduce their volume, toxicity or mobility. This category of technologies considered for the NL site include washing/extraction and hydro-metallurgical leaching.

o Washing/Extraction

Description: Washing and extraction technology would involve the extraction of contaminants from the material using acids, solvents, surfactants, chelating agents, etc. Contaminated material is removed and treated with extractant solution in a washer/extractor. The spent washing/extraction solution containing contaminants would be further treated before disposal. The treated material would be rinsed, neutralized, if necessary, and disposed of.

Initial Screening: Slag and lead oxide material at the NL site have high concentrations of inorganic contaminants including lead, zinc, copper and cadmium. Results available at this time indicate that soils from battery recycling operations, in general, are not highly responsive to soil washing conditions tested by EPA. Total lead concentration was virtually unchanged in several of the soil residues after treatment, separation, and rinsing. It appears that contaminated materials that have undergone years of neglect and weathering may not readily respond to washing as a remedial treatment technology. It was also concluded that lead cannot be physically separated from the contaminated material or concentrated into a smaller volume by particle size separation. EDTA is found to be an extraction agent for lead, but the presence of other metals such as cadmium at the NL site may not make this technology effective. Multiple steps of washing/extraction may be required. In addition, washed or extracted solution needs extensive treatment for recovery/recycling. This technology is therefore eliminated from further evaluation (Table 4-2).

o Hydro-Metallurgical Leaching

Description: The hydro-metallurgical leaching process technology is based on the principles of hydro-metallurgy commonly used for the extraction of metals from ores. This technique uses a hot aqueous caustic leach solution for the extraction of heavy metals from waste residues. This solution

can be regenerated after recovery of the dissolved metal values for subsequent leaching, thus minimizing reagent costs, reducing the waste volume and generating a marketable product from the existing toxic contaminants.

Initial Screening: Hydro-metallurgical leaching technology is based on the ability of caustic solutions to efficiently extract oxidic lead compounds (lead oxide) from the complex residue assemblages without attacking the significant volumes of inert material present in the residues. An additional advantage is that lead metal may be recovered from the leach solutions in a precipitation reaction using a variety of reactive metals. This technology is therefore retained for further consideration (Tables 4-1 and 4-2).

o Stabilization/Solidification

Description: Stabilization/solidification, also known as fixation, is a physical-chemical process whereby contaminated materials are converted into a stable, cement-like matrix in which contaminants are bound and become immobile. Cement, lime, flyash, organic polymers, pozzolan, asphalt and silicates can stabilize contaminants such as heavy metals. Commercial proprietary agents are available for both organic and inorganic contaminant stabilization. Stabilized material develops properties ranging from those of loose sand or gravel to weak concrete. The stabilized products would meet the TCLP requirements.

Initial Screening: Major contaminants in slag and lead oxide piles and other waste materials at the NL site are heavy metals. Available data suggest that silicates in combination with lime or cement could be used for stabilization of metals. The stabilization/solidification technologies are inherently attractive because of the ease in handling of metal wastes. This technology is widely used for metal wastes. Before stabilization/solidification, the waste material may be pretreated to adjust pH and to insolubilize heavy metals, thereby reducing their mobility. The high alkalinity of most cements and stabilizing agents would serve to neutralize acidic leachate, keeping heavy metals in their insoluble, less mobile form. Due to a wide range of applicability, the use of less expensive reagents, and effectiveness in producing solid mass with low permeability that resists leaching, this technology is retained for further consideration (Tables 4-1 and 4-2).

4.1.3.3.4 Disposal

This category of remedial technologies refers to disposal of contaminated materials or secondary wastes generated from treatment systems, on or off site, and with or without any treatment. The disposal technologies included for consideration are on-site and off-site RCRA landfill and on-site and off-site nonhazardous disposal.

o On-Site Landfill

Description: There is an existing State-permitted landfill in the northern portion of the site. The landfill was used by NL Industries to bury crushed casings from automotive battery recycling operation.

Initial Screening: The on-site landfill is now closed and cannot accept any more waste without major modifications. This technology is therefore eliminated from further consideration (Table 4-1).

o Off-Site Hazardous Landfill

Description: Contaminated or treated slag and lead oxide material could be hauled to an existing RCRA Subtitle C landfill which is permitted to accept hazardous materials. This provides a possible solution to the disposal problem, but the commercial RCRA facility availability is limited.

Initial Screening: In addition to high disposal cost, there may be a limitation on the types of waste that can be disposed of at these facilities. The Land Disposal Restrictions (LDR) prohibit off-site landfilling without treatment. However slag and lead oxide materials may be disposed of without treatment under national capacity variance provisions of LDR for a limited time period (up to May 8, 1992). Use of an off-site RCRA landfill may be required as a component of alternatives requiring disposal of treated waste materials and secondary wastes generated during treatment if these wastes are considered hazardous. The off-site RCRA landfill option is therefore retained for further consideration as a process option (Tables 4-1 and 4-2).

o On-Site Disposal

Description: This technology would allow construction of a nonhazardous Subtitle D landfill on site for on-site disposal of treated waste material if it passes TCLP and does not contain any RCRA listed wastes and is considered nonhazardous. Disposal of the treated material would occur on site in accordance with RCRA treatment standards.

Initial Screening: If the treated material passes the TCLP and does not contain any RCRA listed wastes, it would be considered nonhazardous and disposed of in a Subtitle D landfill constructed on site. There is sufficient space on site to construct a landfill. This disposal option is therefore retained for further consideration (Tables 4-1 and 4-2).

o Off-Site Nonhazardous Disposal

Description: An existing licensed Subtitle D nonhazardous landfill within New Jersey or neighboring states could be used for the disposal of nonhazardous or treated hazardous material, if the material does not contain any RCRA listed wastes and passes TCLP.

Initial Screening: This technology would facilitate the off-site disposal of treated waste material and/or untreated waste if LDR does not apply to the waste or secondary wastes generated during treatment. Therefore this disposal option is retained for further consideration (Tables 4-1 and 4-2).

4.1.3.4 Screening and Evaluation of Debris and Contaminated Surfaces Decontamination (Building and Equipment) Technologies

In the following subsections, potential remedial technologies for the debris and contaminated surfaces are briefly described and summarized with the results of the screening evaluation. For those technologies which were not retained for further evaluation, the rationale for their elimination is included. The screening evaluations for each remediation technology is summarized in Table 4-3. Evaluation and selection of process options are presented in Table 4-4. Any debris for which markets are available would be recycled.

4.1.3.4.1 No Action

No Action is not a category of technologies and no remediation measures will be implemented. No Action may include a monitoring program and contaminant migration assessments.

o No Action

Description: The No Action alternative will be considered later in this report as required by the CERCLA, as amended. The No Action approach includes contaminant monitoring in the building and assessing their migration periodically.

Initial Screening: The RI demonstrated widespread presence of metal-contaminated dust on walls, ceiling, floors, structural members, piping and ancillary equipment. The analytical data indicated high concentration of lead, iron, cadmium, nickel and copper throughout the building. Other metals such as aluminum, cobalt, arsenic, and vanadium were found in lower concentrations. A potential risk to public health could exist by direct contact or inhalation in the buildings. Contaminated surfaces are also a source of contaminated runoff. However the buildings are currently locked and are inaccessible.

TABLE 4-3

IDENTIFICATION AND INITIAL SCREENING OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS FOR DEBRIS AND CONTAMINATED SURFACES

GENERAL RESPONSE ACTION	TECHNOLOGY TYPE	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS
No Action	No Action	Monitoring, Public Awareness Program	No remedial action. Long-term monitoring and public awareness programs are implemented.	Potentially applicable. Provides baseline against which other remedial technologies can be compared. Required for consideration by CERCLA, as amended.
Decontamination	Physical	Dusting/ Vacuuming/ Wiping	Physical removal of hazardous dust and particles from contaminated surfaces by common cleaning techniques.	Potentially applicable to certain contaminated surfaces.
		Gritblasting	Surface removal technique in which abrasive material is used for uniform removal of contaminated surface layers from contaminated surfaces.	Not feasible because gritblasting would require removal of pipes bolted to walls. Corners may not be grit blasted effectively. Not applicable to plastic and grass surfaces. Generates a large volume of dust and debris.
		Hydroblasting/ Waterwashing	A high pressure water jet is used to remove contaminants from surfaces.	Potentially applicable to certain contaminated surfaces.
		Steam Cleaning	Physically extracts contaminants from surfaces by high pressure steam. Condensed steam is treated to remove contaminants.	Potentially applicable.
		Fixative/ Stabilizer Coating	Contaminants are physically separated from the ambient environment by a barrier such as epoxy resins, paints etc.	Since most of the contaminants are in particulate form on surface, not applicable as primary technology but potentially applicable as additional protection to seal residual contaminants on decontaminated surfaces.

TABLE 4-4

EVALUATION OF REMEDIAL TECHNOLOGIES FOR DEBRIS AND CONTAMINATED SURFACES

GENERAL RESPONSE ACTION	TECHNOLOGY TYPE/ PROCESS OPTION(S)	EFFECTIVENESS	IMPLEMENTABILITY	COST	STATUS
No Action	No Action: Monitoring, Public Awareness Program	<ul style="list-style-type: none"> - Does not meet remedial objective of eliminating chemical threat to human health and the environment - Does not remove contaminants 	<ul style="list-style-type: none"> - Easy to implement 	Low	Retained for further consideration, as required by CERCLA, as amended - Does not remove conta-
Decontamination	Physical: - Dusting/Vacuuming/ Wiping	<ul style="list-style-type: none"> - Effective for removal of surface contamination 	<ul style="list-style-type: none"> - Readily implementable - Collected dust will require treatment and/or disposal 	Low	Retained for further consideration
	- Hydroblasting/ Water Washing	<ul style="list-style-type: none"> - Effective for removal of embedded material 	<ul style="list-style-type: none"> - Readily implementable - Can not be used in areas of the building containing asbestos - Can not be used in weak sections of the building - Collected water will require treatment 	High	Retained for further consideration
	- Steam Cleaning	<ul style="list-style-type: none"> - Effective for physical removal of contaminants 	<ul style="list-style-type: none"> - Commercially available - Labor intensive and costly - Generates large volume of contaminated water 	High	Eliminated from further consideration because hydroblasting can achieve same results at lower cost
	- Fixative/Stabilizer Coating	<ul style="list-style-type: none"> - Effective for embedded contaminants that cannot be effectively removed by physical means - Does not remove contaminants but reduce mobility 	<ul style="list-style-type: none"> - Readily implementable 	High	Retained for further consideration

Although No Action would not meet remedial objectives, it would be retained through the detailed evaluation as a baseline comparison with other alternatives for contaminated surface remediation (Table 4-3 and 4-4).

4.1.3.4.2 Decontamination

Decontamination is the process of removing contaminants from buildings, structures and equipment. Decontamination is important in preventing the spread of contamination and in reducing exposure levels, so that the building poses no chemical threat to human health and the environment.

o Dusting/Vacuuming/Wiping

Description: This method entails the physical removal of hazardous dust and particulates from the buildings using common cleaning techniques. The advantages of this method include the small volume of secondary waste generated. In addition, wastes are contained in vacuum cleaner bags or on wipe clothes which are easily treated or disposed of.

Initial Screening: This procedure is feasible for the buildings and the equipment on the site. The sampling results indicate that all of the contamination is located on the surface. This removal procedure is well suited for removing dust and particulates from all surfaces. This technology is therefore retained for further consideration (Tables 4-3 and 4-4).

o Gritblasting

Description: This method is a surface removal technique in which an abrasive material is used for uniform removal of contaminated surface layers. Surface layer contaminants are completely removed by gritblasting, a method which is effective for depths ranging from 0.5 to 1.5 cm.

Initial Screening: Gritblasting would require the removal of pipes bolted to the walls. Corners may not be gritblasted as effectively as flat surfaces. Grit blasting is not applicable to plastic and glass surfaces. Large amounts of dust and debris are generated by this process, which would require subsequent removal and disposal. This method is relatively slow. It is believed that most of the contaminants are in the dust on the surface (i.e., walls and floors of the buildings and equipment surfaces) and it is feasible to remove all surface contaminants using simpler surface dust removal techniques such as dusting/vacuuming/wiping. Therefore, gritblasting is eliminated from further evaluation (Tables 4-3).

o Hydroblasting/Waterwashing

Description: A high pressure (3,500 to 350,000 KPa) water jet is used to remove contaminated dust from surface layers. Hydroblasting can incorporate variations such as hot or cold

water, abrasives, solvents, surfactants, and varied operating pressures. The contaminants and water are then collected, treated and disposed of.

Initial Screening: Hydroblasting offers a relatively inexpensive surface decontamination technique that uses off-the-shelf equipment. Many manufacturers produce a wide range of hydroblasting systems and high pressure pumps. Hydroblasting may not effectively remove contaminants that have penetrated the surface layer. Also, large amounts of contaminated liquids must be collected and treated. Hydroblasting can be used on contaminated concrete, brick, metal and other materials. However it is not applicable to wooden or fiberboard materials. During structural inspection of the buildings, it was concluded that some of the structural members of the buildings particularly stairs, walkways and suspension system for ventilation units, are in poor condition to withstand high pressures resulting from hydroblasting. Also, the kiln burner, feed and decasing buildings have asbestos panels for the walls and roof which may become loose when subjected to high pressures. In addition plastic panels and glass cannot withstand high pressures. However other parts of the buildings and equipment surfaces may be cleaned by hydroblasting. Therefore this technology is retained for further consideration (Tables 4-3 and 4-4).

o Steam Cleaning

Description: Steam cleaning physically extracts contaminants from the building materials and equipment surfaces. The steam is applied by hand-held wands or automated systems, and the condensate is collected for treatment.

Initial Screening: Steam cleaning is a simple technique. This technique is known to be effective only for surface decontamination. Steam cleaning is a labor-intensive process that is costly if automated. Mechanical removal of contaminants actually takes place because of the limited solubility of many residues in water particularly metal contaminated dust. Large volumes of contaminated water are generated. Due to the availability of simpler technologies such as dusting/vacuuming/wiping and hydroblasting/water washing for removing dust, this technology is eliminated from further consideration (Table 4-4).

o Fixative/Stabilizer Coatings

Description: Various agents can be used as coatings on contaminated surfaces to fix or stabilize the contaminant in place and decrease or eliminate exposure hazards. Stabilizing agents include waxes, organic dyes, epoxy, paint films and polyester resins.

Initial Screening: This technology is applicable if contaminants have penetrated beyond the surface layer and removal is not feasible. It is believed that most of the contaminants on walls and floors are in the dust on the surfaces in the buildings, and it is feasible to remove all surface contaminants by using simpler dust removal techniques. This technology however may be used as extra protection to seal any residual contaminants remaining after the initial removal and is therefore retained for further evaluation (Tables 4-3 and 4-4).

4.1.3.5 Screening and Evaluation of Standing Water and Sediment Remediation Technologies

In the following subsections, potential standing water remedial technologies are briefly described and the results of the screening and evaluation are summarized. For those technologies which were not retained for further evaluation, the rationale for their elimination is included. The screening evaluations for each identified standing water and sediment remedial technology are summarized in Table 4-5. Evaluation and selection of process options are presented in Table 4-6.

4.1.3.5.1 No Action

No Action is not a category of technologies and no remediation measures will be implemented. No Action may include monitoring program and contaminant migration assessments.

o No Action

Description: The No Action alternative will be considered in this report as required by the CERCLA, as amended to address the site contamination problem when no remediation measure will be taken to reduce the risk of further contamination or other health hazards. The No Action approach includes monitoring standing water and periodically assessing contaminant migration by sampling groundwater and surface runoff.

Initial Screening: Samples of standing water collected by EPA's TAT contractor were found to have high concentrations of lead, iron and other metals. The contamination in standing water is suspected of originating from slag piles and other hazardous waste materials on site. A number of contaminants exceed discharge standards applicable to the site. The groundwater in the vicinity of the NL site is currently used for municipal or private potable water purposes. A potential risk to public health could exist, assuming that no remediation measures are taken. In this alternative reduction in toxicity, mobility and/or volume of contaminated standing water is left to natural attenuation, since no treatment would be implemented. The volume of contaminated standing water would continue to increase due to accumulation of rain water and subsequent runoff which would contaminate surface waters. However, the No Action option is retained through the detailed evaluation as a baseline condition for comparison with other alternatives for standing water remediation (Tables 4-5 and 4-6).

TABLE 4-5

IDENTIFICATION AND INITIAL SCREENING OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS FOR STANDING WATER AND SEDIMENTS

GENERAL RESPONSE ACTION	TECHNOLOGY TYPE	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS
No Action	No Action	Monitoring, Public Awareness Program	No remedial action. Long-term monitoring and public awareness programs are implemented.	Potentially applicable. Provides baseline against which other remedial technologies can be compared. Required for consideration by CERCLA, as amended.
Pumping	Not Applicable	Various Types of Pumps	Standing water is pumped using pumping equipment	Potentially applicable. Pumping would be required as initial water handling step in standing water remedial alternatives.
Treatment	Physical	Clarification	Gravity settling process which allows solids to collect at the bottom of a containment vessel leaving clear liquid at the top.	Potentially feasible for removal of suspended and precipitated solids.
		Flocculation	Promotes agglomeration and settling of suspended solids.	Potentially feasible for removal of suspended and precipitated solids.
		Filtration	Separates suspended solids from a liquid by passing the liquid mixture through porous media.	Potentially feasible for removal of non-settleable suspended and precipitated solids.
		Reverse Osmosis	Treats water by concentrating the dissolved solids. Membrane separates concentrated contaminants from liquid. High pressures are maintained on concentrated contaminants, forcing the liquid through membrane.	Not feasible since suspended solids in water may damage the membrane making it ineffective.
		Sludge Dewatering	Physical process for separation, concentration and dewatering of sludge from solid/liquid separation (clarification, filtration) processes.	Potentially applicable for handling certain process residues (sludge from clarifier, filter). It may also be used to dewater sediments underlying the standing water.

TABLE 4-5

IDENTIFICATION AND INITIAL SCREENING OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS FOR STANDING WATER AND SEDIMENTS

GENERAL RESPONSE ACTION	TECHNOLOGY TYPE	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS
	Chemical	Neutralization/ pH Adjustment	Chemical process in which acids and alkalies are treated to eliminate or reduce their reactivity and corrosiveness.	Feasible as a part of other remedial technologies.
		Precipitation	Chemical process in which acid or base are added to adjust the pH to a point where the constituents to be removed have their lowest solubility or, other precipitants such as sodium sulfide or ferric chloride are added where certain contaminants can be precipitated.	Potentially feasible for metal removal.
		Ion Exchange	Process whereby selective ion from the waste stream are removed from the aqueous phase and replaced by less harmful ions held by ion exchange resins.	Potentially applicable for removal of metals.
		Ion Replacement	Process whereby heavy metal cations are removed from the waste stream by synthetic igneous earth-matrix and bonded strongly to the matrix.	Potentially applicable for removal of metals.
Disposal	Off-site Disposal	Off-site Treatment and Disposal	Standing water and water generated from decontamination activities would be transported to off-site permitted treatment and disposal facility.	Potentially applicable.

TABLE 4-5

IDENTIFICATION AND INITIAL SCREENING OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS FOR STANDING WATER AND SEDIMENTS

GENERAL RESPONSE ACTION	TECHNOLOGY TYPE	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS
	On-site Disposal	Surface Discharge	Treated water is discharged to the surface streams on site.	Not feasible due to intermittent brackish water streams in sensitive Delaware River Basin watersheds leading to stringent discharge criteria and excessive cost.
		Recharge	Treated groundwater would be recharged to the aquifer using injection wells or infiltration basins.	Potentially applicable.

TABLE 4-6
EVALUATION OF REMEDIAL TECHNOLOGIES FOR STANDING WATER AND SEDIMENTS

GENERAL RESPONSE ACTION	TECHNOLOGY TYPE/ PROCESS OPTION(S)	EFFECTIVENESS	IMPLEMENTABILITY	COST	STATUS
No Action	Monitoring, Public Awareness Program	<ul style="list-style-type: none"> - Useful for documenting conditions - Does not reduce toxicity, mobility or volume - Protective by reducing risk of direct contact with contaminated water - Not protective of environment - Reliability is dependent on future maintenance and enforcement 	<ul style="list-style-type: none"> - Easily implemented - Periodic inspection and maintenance required - Enforcement may be difficult 	Low	Retained for further consideration as required by CERCLA, as amended
Pumping	Various types of pumps	<ul style="list-style-type: none"> - Effective in removing contaminated water for treatment and/or disposal - Eliminates uncontrolled migration of contaminated water 	<ul style="list-style-type: none"> - Uses readily available equipment - Easy to implement 	Low	Retained for further consideration. Required component of all treatment and/or disposal alternatives
Treatment	Physical: - Clarification	<ul style="list-style-type: none"> - Effective in separating suspended particulates from liquid phase 	<ul style="list-style-type: none"> - Clarifiers are available commercially and are easily installed 	Low	Retained for further consideration
	- Flocculation	<ul style="list-style-type: none"> - Effective in flocculating and agglomeration of chemical precipitants 	<ul style="list-style-type: none"> - Technically feasible and available 	Low	Retained for further consideration
	- Filtration	<ul style="list-style-type: none"> - Removes particulate-borne contaminants from water - Contaminated particulates must be treated/disposed - Effective in separating less settleable suspended solids from liquid 	<ul style="list-style-type: none"> - Technically feasible and available - May be necessary prior to other treatments 	Low	Retained for further consideration
	- Sludge Dewatering	<ul style="list-style-type: none"> - Effective in reducing water content in sludge and sediments, thereby reducing volume of sludge and sediments for disposal 	<ul style="list-style-type: none"> - Uses readily available equipments - Easily implemented 	Moderate	Retained for further consideration

TABLE 4-6 (Cont'd)
EVALUATION OF REMEDIAL TECHNOLOGIES FOR STANDING WATER AND SEDIMENTS

GENERAL RESPONSE ACTION	TECHNOLOGY TYPE/ PROCESS OPTION(S)	EFFECTIVENESS	IMPLEMENTABILITY	COST	STATUS
	Chemical: - Neutralization/ pH Adjustment	- Effective in optimizing other treatment processes and neutralizing treated standing water	- Easily implemented - Chemical handling requires proper care	High	Retained for further consideration
	- Precipitation	- Effective in precipitating dissolved metal conta- minants from water	- Easily implemented - Sludge requires treatment and disposal	Moderate	Retained for further consideration
	- Ion Exchange	- Highly effective in removing metallic ions in in contaminated water - Spent resin requires regeneration or disposal	- Proven technology - Mobile units available - Filtration to remove suspended solids and pH adjustment may be required prior to ion exchange	High	Retained for further consideration
	Ion Replacement	- Highly effective in removing metallic ions in contaminated water - Spent media does not require regeneration. - Spent media can be disposed of as non- hazardous waste, if it passes TCLP test.	- Innovative technology - Mobile unit available - Filtration to remove suspended solids may be required.	High	Retained for further consideration
	Off-Site Disposal: - Off-Site Treatment and Disposal	- Effectively reduces toxicity, mobility and volume of contaminants - Protective of human health and the environment - Involves transportation of contaminated water through populated areas	- Off-site treatment and disposal facilities available	High	Retained for further consideration
Disposal	On-Site Disposal: - Recharge	- Effective for disposal of treated water	- Easily implemented - Treated water must meet applicable treat- ment standards	Low	Retained for further consideration

4.1.3.5.2 Pumping

Description: Pumping is required in order to remove standing water and sediments from surface impoundments and the refining building basement. Water pumped from the impoundments would be managed to prevent degradation of the surrounding environment. Water may be pumped to a treatment system or tanker trucks for off-site transport to a treatment and disposal facility. Types of pumps used vary with application.

Initial Screening: Pumping would be required as the initial handling step in standing water remedial alternatives. Pumps would be used to pump standing water from ponded areas and the refining building basement. Pumping technology is therefore retained for further consideration (Tables 4-5 and 4-6).

4.1.3.5.3 Treatment

Treatment technologies are used to change the physical and/or chemical state of a contaminant or to destroy the contaminant completely in order to reduce toxicity, mobility and/or volume of contaminants present in the standing water. The categories of treatment technologies considered for the NL site include physical and chemical treatment. These technologies can be implemented on site or at off-site treatment and disposal facilities. On-site treatment can be performed using a mobile treatment system.

Physical Treatment

Physical treatment utilizes a change of physical properties or processes in treating contaminants in standing water in order to reduce their volume, toxicity or mobility. Physical technologies considered for contaminated standing water treatment include clarification, flocculation, filtration, reverse osmosis and sludge dewatering.

o Clarification

Description: The primary function of clarification is to remove settleable suspended solids from a waste stream. The clarifier is equipped with a solids removal device to facilitate the clarification on a continuous basis. The performance of the clarifier is based on design criteria such as surface loading rate and detention time.

Initial Screening: Clarification has been shown to be applicable for the removal of suspended solids from contaminated water (e.g. chemical precipitation processes). This technology would produce sludge which would require further treatment and/or disposal. This technology could be applied as pretreatment for technologies requiring low influent suspended

solids or following chemical precipitation for metal and suspended solids removal. Therefore it is retained for further evaluation (Tables 4-5 and 4-6).

o Flocculation

Description: Flocculation is a physical treatment technology which is used to enhance sedimentation and could be used as a pretreatment technology for removal of suspended solids and metals from standing water. The contaminated water is slowly mixed (following rapid mixing and addition of chemical precipitant) by a paddle while a flocculating chemical is added. Flocculants adhere readily to suspended solids and with each other (agglomeration) so that the resultant particles are too heavy to remain in suspension. The effectiveness of flocculation is dependent upon the flow rate of the contaminated water, its composition and pH.

Initial Screening: Treatment of contaminated standing water on the site may involve precipitation of suspended solids and metals. This technology is well-developed and used in many physical/chemical treatment systems. Therefore this technology is retained for further evaluation (Tables 4-5 and 4-6).

o Filtration

Description: Filtration is used to remove fine suspended particles that are not easily settleable. Filtration was typically used after clarification to remove nonsettleable suspended solids. The most common method of filtration uses sand filters or mixed media filters. A mixed media filtration system consists of a layer of anthracite and a layer of sand to effect the filtration and adsorption of fine particles, including those that would be generated during chemical precipitation. Fluid flow through the filter medium may be accomplished by gravity or under pressure.

Initial Screening: Granular media filtration is typically used after gravity separation for additional removal of suspended solids prior to other treatment processes. This technology would result in contaminated media which would require treatment and/or disposal at the end of the project. Treatment by filtration is appropriate for removal of suspended solids or chemically precipitated solids from the water. Therefore it is retained for further consideration (Tables 4-5 and 4-6).

o Reverse Osmosis

Description: Reverse osmosis is the application of sufficient pressure to the concentrated solution to overcome the osmotic pressure and force the net flow of water through the semipermeable membrane toward the dilute phase. This allows the concentration of solute (impurities) to be built up in a circulating system on one side of the membrane while relatively

pure water is transported through the membrane. Ions and small molecules in true solution can be separated from water by this technique. The basic components of reverse osmosis unit are the membrane, a membrane support structure, a containing vessel, and a high pressure pump. The membrane and membrane support structure are the most critical elements.

Initial Screening: Reverse osmosis is used to reduce the concentrations of dissolved solids, both organic and inorganic. In general, good removal can be expected for high molecular weight organics and charged anions and cations. Reverse osmosis units are subject to chemical attack, fouling and plugging. Pretreatment requirements can be extensive. Water must be pretreated to remove oxidizing materials such as iron and manganese salts to filter out particulates. Standing water at the NL site contain high metal concentration and suspended solids. Suspended solids would be abrasive and could damage the membrane making it ineffective. This technology is therefore eliminated from further consideration (Table 4-5).

o Sludge Dewatering

Description: Sludge dewatering is a treatment process by which the water content of a dilute sludge can be reduced so that the final volume of the sludge requiring disposal is minimized. Sludge dewatering can be achieved using vacuum filtration, a belt filter or a filter press. Vacuum filtration is generally conducted using a horizontal rotating drum covered with a cloth filter medium which is particularly suited for dewatering slurries. The plate and frame filter is operated in batch rather than continuous modes (also suited for sludge dewatering). A variation on this technology is the belt filter press which can be operated continuously.

Initial Screening: Application of these physical treatment methods is anticipated for dewatering sludges generated during the physical-chemical precipitation process. In addition, sediments underlying the standing water may require dewatering before treatment and/or disposal. Sludge dewatering is therefore retained as a feasible technology for further evaluation (Tables 4-5 and 4-6).

Chemical Treatment

Chemical treatment is a category of technologies which utilize chemical reactions or changes of chemical properties of contaminants in standing water to reduce their volume, toxicity or mobility. Chemical treatment technologies considered include neutralization/pH adjustment, chemical precipitation, and ion exchange.

o Neutralization/pH Adjustment

Description: Neutralization is a process used to adjust the pH (acidity or alkalinity) of water to an acceptable level for discharge, which is usually between the range of 6.0 to 9.0 pH units. pH adjustment is a partial neutralization process which makes the water either more acidic or more alkaline to enhance chemical reactions. Adjustment of pH is accomplished by the addition of acidic reagents to alkaline streams and vice versa. pH adjustment can also be used to optimize other treatment processes.

Initial Screening: Neutralization/pH adjustment is a conventional and widely demonstrated means of adjusting the pH of water before, during and/or after chemical precipitation. Adjustment of pH may also be required to optimize other treatment processes. For this reason, neutralization/pH adjustment is retained for further consideration (Tables 4-5 and 4-6).

o Chemical Precipitation

Description: Chemical precipitation is a process in which an acid or a base is added to a solution to adjust its pH to the point where the lowest solubility of the compounds to be removed is reached. Following similar principles, other precipitation agents such as lime, sodium sulfide or ferric chloride may be added for the removal of metals in standing water. Metals can be precipitated out of solution as hydroxides, sulfides, carbonates, or other insoluble salts. The resulting products are metal sludges, the treated effluent with a generally elevated pH and a small quantity of excess sulfide (in the case of sulfide precipitation).

Initial Screening: Limitations to be considered during design include the fact that all metals do not have a common pH at which they precipitate. If present, chelating and complexing agents can interfere with the process. Chemical precipitation is used effectively in conventional water treatment to remove metals and suspended solids. Standing water at the NL site requires metals removal. Principal metals of concern are lead and cadmium. These metals can be effectively precipitated. Therefore, chemical precipitation is retained for further consideration (Tables 4-5 and 4-6).

o Ion Exchange

Description: Ion exchange is a process whereby selected contaminant ions are removed from the aqueous phase by electrostatic exchange with relatively innocuous ions held by ion exchange resins. Ion exchange is used to remove all metallic cations or anions, inorganic anions, organic acids and organic amines. Fixed bed and counter-current systems are the most widely used ion exchangers, while continuous counter-current systems are suitable for high flows.

Initial Screening: Ion exchange can effectively lower all the metals in the standing water below the discharge standards. Ion exchange would generate spent regeneration solution containing high metal concentrations. Treatment and/or disposal of this waste stream would result in additional costs. Although all the metals can be removed to acceptable levels by chemical precipitation, ion exchange is also feasible for removal of metals from the contaminated standing water at this site. Ion exchange can be used as a polishing treatment for water to satisfy disposal standards, if required. Therefore it is retained for further consideration (Table 4-5 and 4-6).

o Ion Replacement

Description: Ion replacement is a process whereby heavy metal cations from the contaminated water are removed by a synthetic igneous earth-matrix material and bonded strongly in the matrix. The metal absorption capacity varies for different metals, with lead, copper, chromium, zinc, iron, nickel absorbed strongly. Cadmium absorption like zinc appears to be concentration dependent. Tin, mercury, manganese, and silver are also absorbed. This technology is available from a vendor under the trade name Ecosorb. Ecosorb material is used at present as a fixed bed, similar to a upflow sand filter. Ecosorb material is produced as a co-product from calcining steel making electric arc furnace dust which contains zinc, lead and cadmium. The principal minerals in the particles include metallic iron, several forms of iron oxide, calcium aluminum silicate, calcium magnesium silicate and calcite. The material is alkaline and has a strong buffering effect. The metal replacement "capacity" of the material is 40-50 pounds of heavy metals per ton of Ecosorb material. Unlike cationic resins, the Ecosorb material is not regenerated but instead it may be disposed of in a nonhazardous landfill because it would pass the TCLP test.

Initial Screening: Ion replacement by Ecosorb can effectively lower all the metal concentrations in the standing water below the surface water and groundwater discharge standards. This process would not generate any sludge, or regeneration solution. Spent material would pass the TCLP test and can be disposed of in a nonhazardous landfill. This technology is therefore retained for further consideration (Table 4-5 and 4-6).

o Off-site Treatment

Description: Contaminated standing water collected from the site would be transported to an off-site RCRA permitted treatment facility for treatment and disposal.

Initial Screening: A number of off-site RCRA permitted water treatment facilities have been located which can accept untreated contaminated standing water from NL site. Due to limited volume of contaminated standing water, on-site treatment

may not be economically viable. Therefore off-site treatment and disposal is retained for further evaluation (Table 4-5 and 4-6).

4.1.3.5.4 Disposal

If one or more of the treatment technologies are incorporated into potential alternatives, the disposal of treated standing water must also be addressed. The potential discharge technologies considered for the NL site include surface discharge and recharge to groundwater through recharge basins or injection wells.

o Surface Discharge

Description: Under this technology, treated standing water would be discharged into nearby streams.

Initial Screening: There are two surface streams (the West stream and the East stream) near the site which were considered for discharging treated standing water. These streams are intermittent. In addition, these streams are located in sensitive watersheds of the Delaware River Basin. Discharge criteria for protection of aquatic life would be significantly more stringent than groundwater remediation levels. For example, the Federal water quality criteria for lead for the stream is 1.3 ug/l compared to groundwater discharge level of 15 ug/l for lead. Although actual discharge limits were not developed, the water quality criteria of 1.3 ug/l provides an approximation of discharge level that might be required. This concentration would be technically feasible but very expensive to achieve. This disposal option is therefore eliminated from further evaluation.

o Recharge

Description: Recharge of treated water is frequently used for disposal of treated water. This is feasible where hydraulic conductivity and transmissivity are high. Recharge of treated water may be accomplished by injection wells or infiltration basins. Potential problems involved with the use of injection systems include sand clogging, dead spots, air locks and plugging by chemical precipitation (particularly injection of aerated water into groundwater with high ion contents).

Initial Screening: Data collected at the site from a pump test established the hydraulic conductivity of the unconfined aquifer underlying the site to range from 1.87 to 45.52 ft/day. Linear groundwater flow ranges from 0.03 to 2.02 ft/day for the unconfined aquifer with an assumed porosity of 0.25. The unconfined aquifer directly beneath the NL site occupies the Cape May and Magothy Formation which are composed of fine to medium-grained brown and gray sands with interspersions of silty clay lenses. The saturated thickness is approximately 20 feet (20 to 40 feet below grade). Although marginal, the aquifer can be used for injection or infiltration of treated standing water. Injection or infiltration capacity may be limited, and therefore may limit treatment rate. Injection can be

accomplished by constructing one or more injection wells. Infiltration can be accomplished by constructing temporary infiltration basins. This technology is therefore retained for further evaluation (Tables 4-5 and 4-6).

4.2 DEVELOPMENT AND INITIAL SCREENING OF REMEDIAL ALTERNATIVES

In this section, the technically feasible remedial technologies identified in Section 4.1 are grouped into potential remedial alternatives for slag and lead oxide piles, debris and contaminated surfaces, and standing water and sediments. These potential remedial alternatives are then screened based on effectiveness, implementability and cost considerations. The purpose of the screening step is to identify those alternatives of sufficient merit to undergo detailed evaluation. This is achieved by eliminating remedial alternatives that have significant adverse environmental or public health impacts or cannot be successfully implemented. Costs may be used to discriminate between treatment alternatives in the screening process, but not between treatment and non-treatment alternatives.

4.2.1 Development of Remedial Alternatives

Remedial action objectives have been established for the remedial program at the NL site, for the protection of public health and the environment as discussed in Sections 3.4.1 through 3.4.3 of this report.

In order to achieve the established remedial action objectives, response criteria are first developed to evaluate the acceptability of environmental and public health impacts and the anticipated performance of the alternative. This step establishes Applicable or Relevant and Appropriate Requirements (ARARs) and other criteria as appropriate to define performance requirements and potential human health risks associated with the remedial alternative. Next, potentially applicable technologies identified in Section 4.1 are used to develop comprehensive medium-specific remedial alternatives on the basis of operation and performance compatibility, and the use of acceptable engineering practices. Finally, the alternatives are evaluated, in a general sense, with respect to effectiveness, implementability and cost criteria. Each step of the process is described in the following sections.

4.2.1.1 Development of Remedial Response Criteria

This subsection describes the use of ARARs in Feasibility Study evaluations and identifies the ARARs used to evaluate the remedial alternatives.

4.2.1.1.1 Use of ARARs and TBCs in Remedial Alternative Evaluation

EPA developed the ARAR concept to govern compliance with environmental and public health statutes. ARARs are used in the FS process to characterize the performance level that a remedial

alternative or a treatment process is capable of achieving. Each remedial alternative and treatment process option must be assessed to evaluate whether it attains or exceeds Federal and State ARARs.

Two types of ARARs exist: "applicable" and "relevant and appropriate" requirements of Federal and State laws. An applicable requirement is any Federal or State standard or limitation that is legally binding on a CERCLA site based on the contaminant, remedial action, or location of the site. In other words, applicable requirements are requirements that would apply to response actions even if actions were not taken pursuant to CERCLA. A "relevant and appropriate" requirement is any Federal or State standard or limitation that, while not applicable to the hazardous substance, action, or location at a CERCLA site, does address problems or situations sufficiently similar to those encountered at the CERCLA site for which its use is suited. When establishing performance goals for remedial alternative selection, relevant and appropriate requirements are given equal weight and consideration as applicable requirements. State requirements are ARARs when promulgated, identified in a timely manner and at least as strict as existing equivalent Federal ARARs.

If no ARAR exists for a CERCLA site, other Federal and State criteria, advisories, guidance, or proposed rules may be considered for developing remedial alternative performance goals. These "to be considered" materials (TBCs) are not legally binding, but may provide useful information or recommended procedures that explain or amplify the content of ARARs. If no ARAR addresses a particular situation, or if existing ARARs do not ensure protection of human health and the environment at a particular site, TBCs should be evaluated for use.

Each type of ARAR can be characterized further as contaminant-specific, action-specific, or location-specific. A contaminant-specific ARAR sets health and risk-based concentration limits in various environmental media for specific hazardous substances or contaminants. An action-specific ARAR sets performance, design, or other similar action-specific controls on particular remedial activities. A location-specific ARAR sets restrictions for conducting activities in particular locations, such as wetlands, flood-plains, national historic districts, and others.

Note that under Section 121 of CERCLA, EPA may waive the need to attain an ARAR if one of the following conditions can be demonstrated:

- o Selection of Interim Remedy - The remedial action selected is only part of a total remedial action that will attain the ARAR level or standard of control when completed.

- o Greater Risk to Human Health and Environment Posed - Compliance with the ARAR at the site will result in greater risk to human health and the environment than the alternative option chosen.
- o Technical Impracticability - Compliance with the requirement is technically impracticable from an engineering perspective.
- o Equivalent Standard of Performance Attained - The remedial action selected will attain a standard of performance that is equivalent to that required under the ARAR through use of another method or approach.
- o Inconsistent Application of State Requirements would Result - The State has not consistently applied (or demonstrated intention to apply consistently) the ARAR in similar circumstances at other remedial actions.
- o Fund Balancing - Attainment of the ARAR would not provide a balance between the need for protection of public health or welfare and the environment and availability of fund amounts to respond to other sites presenting a threat to the public or environment (for fund financed cleanups only).

4.2.1.1.2 Identification of ARARs and TBCs for the NL Site

This section presents a general listing and discussion of the Federal and New Jersey ARARs and TBCs utilized in this Feasibility Study. See Tables 4-7, 4-8, and 4-9 for a more specific ARAR listing.

Listing of ARARs and TBCs

This listing is organized into the categories of contaminant-specific, location-specific and action-specific ARARs. See Tables 4-7, 4-8, and 4-9.

1) Contaminant-Specific

Federal

- o Clean Water Act, Water Quality Criteria (Section 304) (May 1, 1987 - Gold Book)
- o RCRA Identification of Hazardous Waste (40 CFR 261)
- o RCRA Land Disposal Restriction (40 CFR 268)

TABLE 4-7
CONTAMINANT-SPECIFIC ARARS, CRITERIA AND GUIDANCE

REGULATORY LEVEL	ARAR IDENTIFICATION	STATUS	REGULATORY SYNOPSIS	FS CONSIDERATION
Federal	CWA Water Quality Criteria (WQC) for protection of Human Health and Aquatic Life ²	Relevant and Appropriate	Contaminant levels regulated by WQC are provided to protect human health in relation to exposure from drinking water and from consuming aquatic organisms (primarily fish).	WQC are relevant and appropriate to evaluation of surface water discharge acceptability.
Federal	RCRA Maximum Contaminant Levels (MCLs) ¹	To be Considered	Provides standards for 14 toxic compounds and pesticides for protection of groundwater. These standards are equal to the MCLs established by SDWA.	The promulgated values are included in the SDWA MCLs. The combined standards are compared with the maximum contaminant levels at the NL site to determine the level of contamination.
Federal	SDWA Maximum Contaminant Levels (MCLs) ¹	To be Considered	Provides standards for toxic compounds for public drinking water.	The promulgated values are used as standards to determine the level of treatment for groundwater discharge.
Federal	SDWA MCL Goals ¹	To Be Considered	EPA has promulgated contaminants levels and has proposed others for public water system. The MCLGs are health goals and are set at levels that would result in no known or anticipated adverse health effects with an adequate margin of safety.	MCLGs are used as reference values to indicate contaminant levels for the NL site.
Federal	RCRA Identification of Hazardous Waste (40 CFR 261)	Applicable	Provides regulations concerning identification and classification of RCRA Hazardous Waste.	Will be used to determine RCRA listed and characteristic waste present at the NL site.
Federal	RCRA Land Disposal Restriction (LDR) (40 CFR 268)	Applicable	Limits land disposal options and provides treatment standards for contaminants prior to disposal.	Treatment standards or BDAT requirements must be met prior to land disposal. Effective for CERCLA soil and debris as of November 1990.
Federal	National Ambient Air Quality Standards (NAAQS) (40 CFR 50)	Applicable	These standards provide acceptable limits for particulate matter, sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, and lead that must not be exceeded in ambient air.	Remediation technologies that could release contaminants into the air will be designed to meet these standards.
Federal	EPA Risk Reference Doses (RfDs)	To Be Considered	RfD's are considered to be the levels unlikely to cause significant adverse health effects associated with a threshold mechanism of action in human exposure for a lifetime.	EPA Reference Doses are used to characterize risk associated with non-carcinogens in various media.

TABLE 4-7 (Cont'd)
CONTAMINANT-SPECIFIC ARARS, CRITERIA AND GUIDANCE

REGULATORY LEVEL	ARAR IDENTIFICATION	STATUS	REGULATORY SYNOPSIS	FS CONSIDERATION
New Jersey	New Jersey Regulations for the Identification of Hazardous Waste (NJAC 7:26-8)	Applicable	Provides regulations concerning the identification and classification of Hazardous Waste	Will be used to determine listed and characteristic hazardous waste at the NL site.
New Jersey	New Jersey Groundwater ¹ Quality Standards	To Be Considered	Provides quality standards for groundwater based on aquifer characteristics and use.	The levels will be compared to levels at the NL site to determine contaminant migration.
New Jersey	New Jersey Safe Drinking ¹ Water Act Maximum Contaminant Levels (MCL's) (NJAC 7:10-16)	To Be Considered	Provides quality standards for drinking water.	These levels will be compared to contaminant levels at the NL site to determine contaminant migration.
New Jersey	New Jersey State Water ² Standards (NJAC 7:9-4)	Relevant and Appropriate	Provides quality standards for surface water.	These standards will be used to determine appropriate levels for discharge to surface water.
New Jersey	New Jersey Ambient Air Quality Standards	Applicable	Provides guidance regarding air emissions.	Remedial activities which cause air emissions will conform to these standards.

1) Applies to alternatives including groundwater monitoring

2) Applies to standing water treatment alternatives

TABLE 4-8
ACTION-SPECIFIC ARARS

REGULATORY LEVEL	ARARS	STATUS	REGULATORY SYNOPSIS
A. Common to all Alternatives	OSHA - General Industries Standards (29 CFR 1910)	Applicable	These standards regulate the 8-hour time weighted average concentration for worker exposure to various compounds. Timing requirements for workers at hazardous wastes operations are also specified.
	OSHA - Safety and Health Standards (29 CFR 1926)	Applicable	This regulation specifies the type of safety equipment and procedures to be followed during site remediation.
	OSHA - Recordkeeping, Reporting and Related Regulations (29 CFR 1904)	Applicable	This regulation outlines the recordkeeping and reporting requirements for an employer under OSHA.
	RCRA TSDF Regulation (40 CFR 264 and 265 subparts A, B, C, D, E, F, G, L, and N)	Relevant and Appropriate	Provides standards for hazardous waste treatment facilities with regard to design and operation of treatment and disposal systems (ie, general facility standards, landfills, incinerators, containers, etc.)
	RCRA Requirements for transporting waste for Off-Site Disposal (40 CFR 263) ³	Relevant and Appropriate	Provides manifest and record keeping requirements for generators of hazardous waste.
	RCRA Standards for Generators of Hazardous Waste (40 CFR 262)	Applicable	General standards for generators of hazardous waste.
	RCRA Nonhazardous Waste Management Standards (40 CFR 257) ²	Applicable	Provides standards for the management of non-hazardous waste under RCRA Subpart D.
	RCRA Groundwater Monitoring Requirements (40 CFR 264 Subpart F) ⁴	Applicable	This regulation details requirements for groundwater monitoring programs.
	National Emission Standards for Hazardous Air Pollutants (NESHAPS) (40 CFR 61)	Relevant and Appropriate	Provides standards for acceptable limits for specific chemicals in air emissions. Requirements address operational, record keeping, and general emission standards that apply to air pollution control equipment.
	DOT Rules for Hazardous Materials Transport (49 CFR 171) ³	Applicable	Provides requirements for the transportation of hazardous waste.
	New Jersey Standards for the Design and Operation of Hazardous Waste Treatment Facilities (NJAC 7:26)	Relevant and Appropriate	This regulation outlines general waste facility requirements with regard to waste analysis, security measures, inspection and training requirements.

TABLE 4-8 (Cont'd)
ACTION-SPECIFIC ARARS

REGULATORY LEVEL	ARARS	STATUS	REGULATORY SYNOPSIS
B. Standing Water and Sediment Treatment	New Jersey Noise Pollution Regulations (NJAC 7:29)	Applicable	Provides standards for the control of noise pollution.
	NPDES Regulations (40 CFR 122)	Applicable	Provides regulations for discharge of the treatment system effluent. Refers to effluent limitations for discharge to surface water.
	New Jersey Pollution Discharge Elimination System Regulations NJAC (7:14A)	Applicable	Provides regulations for discharge of pollutants to surface water of the State.
C. Slag and Lead Oxide Materials, Debris and Contaminated Surfaces	RCRA Closure and Post-Closure Standards (40 CFR 264, Subpart G)	Relevant and Appropriate	This regulation details specific requirements for closure and post-closure of hazardous waste facilities.
	RCRA Subtitle D Nonhazardous Waste Management Standards (40 CFR 257) ¹	Applicable	Provides regulations for the management of non-hazardous waste.
	RCRA Land Disposal Restrictions (LDRs) (40 CFR 268)	Applicable	Regulates land disposal of hazardous waste. Provides treatment levels which must be met before land disposal of hazardous waste may occur.
	New Jersey RCRA Closure and Post-Closure Standards (NJAC 7:26)	Relevant and Appropriate	This regulation details specific requirements for closure and post-closure of hazardous waste facilities.
	New Jersey Standards for Generators of Hazardous Waste (NJAC 7:26)	Applicable	General Standards for generators of hazardous waste.
	New Jersey Air Pollution Control Requirements (NJAC 7:27)	Applicable	Provides guidelines for the control of Air contaminants.
	New Jersey Soil Erosion and Sediment Control Act Requirements ¹	Applicable	Provides guidelines for soil erosion and sediment control plans.

1) Applies to alternatives remediating slag and lead oxide materials only.

2) Applies to alternative which involve on-site disposal.

3) Applies to alternatives which involve off-site transportation

4) Applies to monitoring of ground and surface waters.

TABLE 4-9
LOCATION-SPECIFIC ARARS

REGULATORY LEVEL	ARARS	STATUS	REQUIREMENT SYNOPSIS
Federal	Fish and Wildlife Coordination Act 16 USC 661	Relevant and Appropriate	Details requirements with regard to the protection of fish and wildlife.
Federal	National Historic Preservation Act	Relevant and Appropriate	Sets forth requirements for the preservation of items of cultural or historic value.
New Jersey	New Jersey Rules on Coastal Resources and Development (7:7E-1.1 et seq)	To be considered	Regulates the development of coastal areas in certain counties in the State of New Jersey.
New Jersey	Delaware River Basins Compact NJSA 58:18-18	To Be Considered	Regulates all projects significantly affecting water resources within the jurisdiction of the Delaware River Basin Commission.

1) Applies to alternatives including discharge to surface waters.

- o National Ambient Air Quality Standards (NAAQS) (40 CFR 50)

New Jersey

- o New Jersey Regulation for Hazardous Waste Identification (NJAC 7:26-8)
- o New Jersey Surface Water Standards (NJAC 7:9-4)
- o New Jersey Ambient Air Quality Standards (NJAC 7:27-13)

2) Location-Specific

Federal

- o National Historic Preservation Act (16 USC 470) Section 106 et seq. (36 CFR 800)
- o Fish and Wildlife Coordination Act (16 USC 661 et seq.)

New Jersey

- o New Jersey Rules on Coastal Resources and Development 7:7E-1.1 et seq.

3) Action-Specific

Federal

- o RCRA Subtitle C Hazardous Waste Treatment Facility Design and Operating Standards for Treatment and Disposal Systems, (i.e., landfill, incinerators, tanks, containers, etc.)(40 CFR 264 and 265) (Minimum Technology Requirements)
- o RCRA Subtitle C Closure and Post-Closure Standards (40 CFR 264, Subpart G)
- o RCRA Standards for Generators of Hazardous Waste (40 CFR 262)
- o RCRA Groundwater Monitoring and Protection Standards (40 CFR 264, Subpart F)
- o RCRA Transporter Requirements for Manifesting Waste for Off-site Disposal (40 CFR 263)
- o RCRA Transporter Requirements for Off-Site Disposal (40 CFR 270)

- o RCRA Subtitle D Nonhazardous Waste Management Standards (40 CFR 257)
- o RCRA Land Disposal Restrictions (40 CFR 268) (On- and off-site disposal of materials)
- o Clean Water Act - NPDES Permitting Requirements for Discharge of Treatment System Effluent (40 CFR 122-125)
- o National Emission Standards for Hazardous Air Pollutants (NESHAPs) (40 CFR 61)
- o DOT Rules for Hazardous Materials Transport (49 CFR 107, 171.1-171.500)
- o Occupational Safety and Health Standards for Hazardous Responses and General Construction Activities (29 CFR 1904, 1910, 1926)

New Jersey

- o New Jersey RCRA Standards for the Design and Operation of Hazardous Waste Treatment Facilities (NJAC 7:26-1 et seq.)
- o New Jersey RCRA Closure and Post-Closure Standards (NJAC 7:26-1 et seq.)
- o New Jersey Noise Pollution Regulations (NJAC 7:29 et seq.)
- o New Jersey Nonhazardous Waste Management Requirements (NJAC 7:26-2)
- o New Jersey Pollutant Discharge Elimination System Regulations (NJPDES) and Effluent Limitations (NJAC 7:14A et seq.)
- o New Jersey Air Pollution Control Regulations (NJAC 7:27 et seq.)
- o New Jersey Soil Erosion and Sediment Control Act Requirements (NJAC 4:24-42 and NJAC 2:90-1.1 et seq.)
- o New Jersey Waste Treatment Regulations (NJAC 7:10-13)

When ARARs do not exist for a particular chemical or remedial activity or when the existing ARARs are not protective of human health or the environment, other criteria, advisories and guidance known as "to be considered (TBCs) material" may be useful in designing and selecting a remedial alternative. The following criteria, advisories and guidance were developed by the EPA, other Federal agencies and State of New Jersey and are also listed in Tables 4-7, 4-8 and 4-9.

Federal

- o Resource Conservation and Recovery Act (RCRA) Groundwater Protection Standards and Maximum Concentration Limits (40 CFR 264, Subpart F)
- o Safe Drinking Water Act, Maximum Contaminant Level Goals (MCLGs), (40 CFR 141)
- o Safe Drinking Water Act, Maximum Contaminant Levels (MCLs) (40 CFR 141.11-.16) (if MCLG is 0)
- o EPA Safe Drinking Water Act - Proposed MCL for Lead (5.0 ppb)
- o EPA Health Effects Assessment (HEAs)
- o EPA Risk Reference Doses
- o Cancer Assessment Group (National Academy of Science) Guidance
- o Fish and Wildlife Coordination Act Advisories

New Jersey

- o New Jersey Groundwater Quality Standards (NJAC 7:9-6)
- o New Jersey Safe Drinking Water Act Maximum Contaminant Levels (MCLs) (NJAC 7:10-16)
- o New Jersey Soil Cleanup Level Objectives
- o New Jersey Regulations on Coastal Zone Development
- o Delaware River Basin Water Quality Regulations

Potential Contaminant-Specific ARARs

Table 4-10 provides a numerical listing of potential contaminant-specific ARARs and TBCs for the NL site.

TABLE 4-10
POTENTIAL CONTAMINANT - SPECIFIC ARARs
(ug/L unless otherwise noted)

COMPOUND	FEDERAL CWA WQC (FISH & WATER) ¹	FEDERAL SDWA MCLs ²	FEDERAL SDWA MCLGs ³	NJ SURFACE WQ STANDARDS ⁴	NJ GROUND WQ STANDARDS ⁵	SITE-SPECIFIC EPA CRITERIA FOR SURFACE DISCHARGE
Arsenic	-	50	-	50	50	0.14 ⁷
Barium	-	1000	5000	1000	1000	-
Cadmium	10	10	5	10	10	0.66 ⁸
Chromium	50	50	1.2	50	50	11 ⁸
Copper	1000	1000	1300	-	-	2.9 ⁸
Lead	50	15 ⁶	20	50	50	1.3 ⁸
Mercury	-	2	-	2	2	0.012 ⁸
Nickel	13.4	-	-	-	-	-
Selenium	-	10	-	10	10	5 ⁸
Silver	50	50	-	50	50	1.2 ⁹
Zinc	5000	-	-	-	-	59 ⁸
Cyanide	200	-	-	-	200	-
pH	-	-	-	6.5-8.5	5-9	-
TDS	-	-	-	-	500,000	NA
BOD (5 day)	-	-	-	-	3,000	-

1. Federal Clean Water Act Water Quality Criteria.

2. Federal Safe Drinking Water Act, Maximum Contaminant levels.

3. Federal Safe Drinking Water Act, Maximum Contaminant Level Goals.

4. New Jersey Surface Water Quality Standards.

5. New Jersey Ground Water Quality Standards.

6. EPA Action Level for Lead - May 7, 1991.

7. EPA recommended criterion for the protection of human health from consumption of aquatic organisms at a 10⁻⁶ risk level.

8. EPA recommended criterion for the protection of aquatic life due to chronic toxicity.

9. EPA recommended criterion for the protection of aquatic life due to acute toxicity.

General Discussions of Key ARARs and TBCs

This subsection presents general discussions of those contaminant-specific ARARs and TBCs which are the key requirements in remedial alternative evaluation and comparison. The focus of these discussions is on distinguishing between alternatives based upon ARARs/TBCs attainment, rather than an exhaustive description of the ARARs/TBCs themselves.

- o Federal and State Drinking Water MCLs

Federal and State MCLs and action levels set levels of contaminants in drinking water, i.e., at the tap, which are protective of human health. EPA guidance indicates that they are relevant and appropriate ARARs for groundwater which is used, or may be used, for drinking.

- o New Jersey PDES Discharge Requirements

New Jersey PDES requirements provide for the use of Best Available Technology (BAT) and Best Conventional Technology (BCT) to control pollutants being discharged into the waters of the State. The requirements also provide approved methods for waste monitoring and quality control.

- o RCRA Closure Requirements

RCRA regulations on clean closure require all waste residues and contaminated containment system components (e.g., liners, foundations, piping and any other ancillary equipment), contaminated subsoils, and structures and equipment contaminated with waste and leachate to be removed and managed as hazardous waste or decontaminated before the site management is completed.

RCRA regulations on waste-in-place closures require that hot spot wastes left in place be capped to ensure long-term site stability, the minimization of waste migration and the protection of human health and the environment. Long-term site monitoring is also required to ensure the closure performance.

- o Federal RCRA Land Disposal Restrictions (LDRs)

RCRA LDRs were enacted to severely restrict the disposal of hazardous wastes in landfills, surface impoundments, injection wells and other forms of land disposal facilities. The LDRs establish Best Demonstrated Available Technology (BDAT) treatment standards for wastes prior to land disposal. RCRA characteristic wastes and RCRA listed hazardous wastes are subject to RCRA LDRs. Waste streams must be evaluated individually to determine application of LDRs in each case.

It is EPA's position that waste which is RCRA characteristic may be disposed of at a subtitle D landfill once it is treated to a point where it is no longer a characteristic waste. However, it is important to note that if a characteristic waste is contaminated with a listed waste, it cannot be sent to a subtitle D landfill. This latter position is based on the "derived from" rule which holds that once a waste is classified as listed, it is always a listed waste until it is delisted.

4.2.1.2 Combination of Potentially Applicable Technologies into Feasible Remedial Alternatives

Based upon the nature and extent of the problem (Section 1.5.1), the contaminant exposure risks (Section 1.5.2) and the subsequent formulation of remedial objectives (Section 3.4), three media requiring remedial action can be identified at the NL site. These media are:

- o Slag and lead oxide piles
- o Debris and contaminated surfaces
- o Standing water and sediments

Slag and Lead Oxide Material Alternatives

The risk evaluation indicates that current and future risks to human health are presented by contact with, ingestion, or inhalation of slag and lead oxide material. It was also determined that runoff via rain erosion and wind erosion is a mechanism for potential release of contaminants into the environment. The contamination in standing water is suspected of originating from slag piles and other waste materials discarded on the site. Potential also exist for site workers and trespassers to be exposed to contaminated dust originating from slag and lead oxide piles through direct contact or inhalation. Remedial objectives that address these risks are identified in Section 3.4. The slag and lead oxide piles (SP) remedial alternatives are formulated so as to achieve these objectives.

As discussed in Section 4.1, four categories of general response actions (No Action, removal, treatment and disposal) are considered in the slag and lead oxide pile alternatives development. Alternative SP-1 (No Action) provides a baseline condition for comparison with other alternatives. The No Action alternative would not provide treatment of slag and lead oxide materials but would monitor migration of contaminants. This alternative would also include a public awareness program.

Treatment alternatives considered for slag and lead oxide materials include vitrification, flame reactor, hydro-metallurgical leaching and stabilization/solidification. All the above technologies would require waste handling. Vitrification and hydro-metallurgical leaching alternatives are considered for on-site treatment because mobile treatment systems may be utilized. Flame reactor treatment is considered

for off-site treatment because mobile treatment systems are not available at this time. Stabilization/solidification is considered for both on-site and off-site application. In addition to treatment alternatives, off-site disposal without treatment is considered. On-site and off-site disposal alternatives are considered for treated materials. If treated materials are disposed of on site, a long-term monitoring program would be instituted to monitor potential migration of residual contaminants from the treated materials. Any treated or untreated materials that could be recycled would be recycled.

Based on the above considerations, the potential remedial alternatives identified for the slag and lead oxide materials are summarized as follows:

- o Alternative SP-1: No Action
- o Alternative SP-2: On-Site Vitrification/On-Site or Off-Site Disposal
- o Alternative SP-3: Off-Site Flame Reactor
- o Alternative SP-4: On-Site Hydro-Metallurgical Leaching/On-Site or Off-Site Disposal
- o Alternative SP-5: On-Site Stabilization (Solidification)/On-Site or Off-Site Disposal
- o Alternative SP-6: Off-Site Stabilization (Solidification)/Off-Site Disposal
- o Alternative SP-7: Off-Site Disposal

Debris and Contaminated Surfaces (Buildings and Equipment) Alternatives

Based on the identification and screening of technology types and process options as discussed in Section 4.1, two alternatives are formulated for decontamination of debris and contaminated surfaces. Alternative CS-1, No Action is developed in order to serve as a baseline against which the other alternative could be compared. To remove contaminated debris and decontaminate process buildings and equipment surfaces for safe entry decontamination, Alternative CS-2 is developed. Depending on the surfaces to be decontaminated a combination of technologies such as dusting/vacuuming/wiping, hydroblasting/waterwashing, would be used. Decontaminated debris would be disposed of

off site. Contaminated dust would be transported off site for treatment and disposal. Contaminated water generated from decontamination operations would be treated and disposed of on site or transported off site for treatment and disposal. Material before or after decontamination would be recycled whenever possible.

Based on the above consideration, the potential remedial alternatives identified for the building are summarized as follows:

- o Alternative CS-1: No Action
- o Alternative CS-2: Debris and Contaminated Surface
Decontamination/Off-Site
Treatment and Disposal

Contaminated Standing Water and Sediment Management Alternatives

The risk evaluation indicates that there is current and future risk to human health and the environment presented by standing water. Accidental ingestion and dermal contact are potential exposure pathways for standing water. Runoff originating from contaminated standing water can also release contaminants into the environment (i.e. surface water and groundwater). Remedial objectives that address these risks are identified in Section 3.4. The standing water and sediment (SW) remedial alternatives are formulated to achieve these objectives.

Standing Water and Sediments (SW) alternatives address the control of contaminant migration through standing water, and cleanup and disposal of the contaminated standing water and sediments underlying the water by pumping and treatment. The SW alternatives are developed based on the following considerations:

- The standing water contaminants include heavy metals in average concentrations above Federal and New Jersey State standards. These standards are listed in Table 4-10.
- An overview of the technology screening for standing water presented in Section 4.1 indicates that the feasible alternatives will fall into no action, pumping, treatment and disposal technologies. The no action alternative would not reduce toxicity, mobility or volume by treatment but would rely on natural attenuation. Pumping would remove contaminated standing water and sediments from the ponded areas for treatment and/or disposal. The treatment and disposal technologies would apply treatment as the key element in the standing water remediation process to protect human health and the environment. Sediments would be disposed of with sludge generated from standing water treatment.

- The on-site standing water remediation alternatives evaluated for the NL site consists of collection, treatment and recharge of treated water. Recharge may be accomplished by injection via injection wells or infiltration through temporary infiltration basins. The collection of surface water would be accomplished by pumping the standing water from ponded areas and basement area in the refining building. All treatment alternatives would have the same collection system. The treatment system for metals removal would include conventional chemical precipitation, clarification and filtration steps. In addition, ion exchange and/or ion replacement would be considered as polishing steps if necessary. All the treatment alternatives would be designed to meet the (New Jersey) State and Federal discharge requirements as far as technically feasible. In addition to on-site treatment alternatives, treatment and disposal alternative at an off-site facility would be considered. Sludge generated along with sediments would be dewatered on site and disposed of off site after treatment.

Based on the standing water remedial technology screening (Section 4.1) and the above considerations, the potential standing water remedial alternatives are summarized as follows:

- o Alternative SW-1: No Action
- o Alternative SW-2: On-Site Treatment and Groundwater Recharge
- o Alternative SW-3: Off-Site Treatment and Disposal

4.2.2 Description and Screening of Remedial Alternatives

The purpose of this section is to describe and screen the remedial alternatives developed in Subsection 4.2.1.2 to narrow down the number of alternatives for detailed analysis while preserving a range of technical options. Screening criteria conform with the remedy selection requirements set forth in CERCLA as amended, Section 121, and in the NCP: (40 CFR 300.68 (g)). Each alternative is evaluated herein for effectiveness, implementability, and cost factors as follows:

- o Effectiveness: A key aspect of the screening evaluation is the effectiveness of each alternative in protecting human health and the environment, by achieving the treatment standards specified for the various media of concern. Each alternative is evaluated as to the protection it would provide and the reductions in

toxicity, mobility, or volume it would achieve. Both short- and long-term components of protection are evaluated. Short-term refers to the construction and implementation period, and long-term refers to the period after the completion of remedial action. Reduction of toxicity, mobility or volume refers to changes in one or more characteristics of the hazardous substances or contaminated media by the use of treatment that decreases the threats or risks associated with the hazardous material.

- o Implementability: Implementability, as a measure of both the technical and administrative feasibility of constructing, operating, and maintaining a remedial alternative. This criterion is used during screening to evaluate the combinations of process options with respect to conditions at a specific site. Technical feasibility refers to the ability to construct, reliably operate, and meet technology-specific regulations for process options until a remedial action is complete. It also includes operation, maintenance, replacement, and monitoring of technical components of an alternative, if required, into the future after the remedial action is complete. Administrative feasibility refers to the ability to obtain approvals from other offices and agencies, the availability of treatment, storage, and disposal services and capacity, and the requirements for and availability of specific equipment and technical specialists.

Determinations of Not Technically Feasible or Not Available will preclude an alternative from further consideration, unless steps can be taken to change the conditions responsible for the determination.

- o Cost: Typically, alternatives will have been defined well enough during screening so that some estimates of cost are available for comparisons among alternatives. However, because uncertainties associated with the definition of alternatives often remain, it may not be practicable to define the costs of alternatives with the desirable accuracy (i.e., +50 percent to -30 percent) used in the detailed analysis. Accuracy for initial screening is +100 percent to -50 percent.

The three major contaminated media of concern at the NL site will be considered separately as slag and lead oxide materials (SP), contaminated surfaces and debris (CS), and standing water and sediments (SW).

4.2.2.1 Slag and Lead Oxide Material Alternatives

4.2.2.1.1 Alternative SP-1: No Action

Description

The No Action alternative provides the baseline case for comparison with other slag and lead oxide material alternatives. In this alternative, the contaminated slag and lead oxide materials are left in place without treatment. A public education program consisting of distribution of circulars, press releases, and public meetings would be provided to increase public awareness. A long-term monitoring program consisting of soil, surface water and groundwater monitoring would be implemented to track the migration of contaminants. Five-year reviews would be performed to assess the need for further actions as required by CERCLA as amended.

Evaluation

- o Effectiveness: The No Action alternative would not meet any of the remedial objectives. This alternative would not involve treatment and therefore it would not reduce the contaminant concentrations and mobility to acceptable levels, nor would it eliminate exposure pathways such as inhalation, ingestion or direct contact with contaminated materials. The short- and long-term public health and environmental threats due to exposure to contaminated materials and release of these materials by wind erosion and surface runoff would be unaltered.
- o Implementability: This No Action alternative can be easily implemented, since it involves no major construction. The technologies associated with monitoring are well developed, reliable and readily available. A public awareness program can be easily implemented. Institutional management of a long-term monitoring program and assessment of site conditions every five years would be required.
- o Cost: This alternative would not involve any construction activity and therefore would not incur any capital cost. Annual operation and maintenance cost for this alternative is estimated to be \$25,000. Five-year review costs are estimated at \$20,000 per review. The present worth based on a 5 percent discount rate for 30 years is \$439,900.

Conclusion

Although this alternative would not meet any of the remedial objectives, it provides a baseline case for comparison with other alternatives, as required by CERCLA, as amended. Therefore it is retained for detailed evaluation.

4.2.2.1.2 Alternative SP-2: On-Site Vitrification/On-site or Off-Site Disposal

Description

Site preparation for this remedial alternative would include an equipment staging area. Support facilities would also be installed. Approximately 9,800 cy of slag material and 200 cy of lead oxide and similar material would be removed from existing piles and treated by Mobile Electric Pyrolyzer system. Removal would be conducted under moistened conditions by spraying water over the surface, to minimize fugitive dust. The Electric Pyrolyzer would include off-gas scrubbing equipment to ensure that the air emission standards would be met. Scrubber waste would be transported off site by the pyrolyzer contractor for treatment and disposal. Pyrolysis takes place in an oxygen deficient atmosphere. The heat produced by the electric energy melts the inorganic materials and forms a glass-like material. This molten material is tapped and cooled to form a non-leachable solid. Slag material treated to pass TCLP would be placed on site in accordance with RCRA treatment standards. For cost estimating purposes, it was assumed that the on-site placement would meet RCRA Subtitle D requirements, although the actual disposal requirements would be defined in design, pending treatability studies. Treated material may be transported off-site for disposal in Subtitle D nonhazardous landfill.

Evaluation

- o Effectiveness: This remedial alternative would achieve all the remedial objectives for the slag and lead oxide materials. The mobility of contaminants would be reduced due to formation of non-leachable slag. This alternative would prevent further contamination by evolution of dust and contaminated runoff. There would be some short-term exposure risk to on-site workers during removal and pyrolysis; however, workers would be properly protected in compliance with the site-specific Health and Safety Plan. Nearby residents and workers in nearby industries may be exposed to fugitive dust if proper controls are not used. This alternative would remove the primary source of contamination at the site, which is currently transporting contaminants through runoff and wind erosion. Therefore, the beneficial effects include removal of contaminants and elimination of contaminant migration. This alternative however, may not be effective for volatile metals such as lead and arsenic because these metals would be volatilized during vitrification and require complex air pollution control equipment to control their emissions. There are no long-term risks to public health or the environment. The length of time until protection is estimated to be three years. This estimate includes design, bidding, contractor selection, mobilization, demobilization and actual remediation time.

- o Implementability: The electric pyrolyzer is currently available from only one vendor. The capacity of a mobile unit is 5 to 20 tons per day, which would require more than three years to achieve complete protection. No full-scale data are available for this technology. The site has easy access and adequate space for equipment and support facility staging. The process requires high electric power usage. Special power connections would be required. During treatment, monitoring of off-gases would be required. Adequate space is available for Subtitle D landfill to be constructed on site for on-site disposal of treated materials. Off-site nonhazardous landfills are also available for disposal of treated material. However, capacities may be limited and it would not provide any additional protection because treated waste would be nonhazardous. If the treated material is disposed of on site, a long-term monitoring program would be instituted to monitor potential migration of contaminants into the environment. Since remediation would take place on a Superfund site, permits would not be required as long as substantive requirements of the permit are satisfied.
- o Costs: The capital costs for this alternative is estimated to be \$4,920,000 for on-site disposal and \$5,927,200 for off-site disposal. Separate operation and maintenance costs are not required for the off-site disposal option since capital cost includes all costs. Annual operation and maintenance cost for the on-site disposal option is estimated at \$17,000. In addition it is estimated to require \$10,000 for each five-year review for on-site disposal option. Present worth would be the same as the capital costs for off-site disposal option. Total present worth for the on-site disposal option is estimated at \$5,209,100.

Conclusion

Due to the limitation in availability of the electric pyrolyzer, its lack of effectiveness in treating volatile metals, low capacity, lack of full scale data, and high costs, this alternative is eliminated from detailed evaluation.

4.2.2.1.3 Alternative SP-3: Off-Site Flame Reactor

Description

Site preparation for this alternative would include an equipment staging area. The equipment staging area would be small compared to Alternative SP-2 because no on-site treatment is involved. Support facilities would also be installed.

Approximately 9,800 cy of slag material and 200 cy of lead oxide and similar material would be removed from existing piles, loaded on trucks or rail cars and transported to a stationary Flame Reactor System. Removal would be conducted under moistened conditions by spraying water over the surface to

minimize fugitive dust. Materials would be packed into the DOT approved containers or super sacks for transport to off-site RCRA-permitted treatment facility for treatment and possibly recycling.

The Flame Reactor is a patented process primarily designed for treatment of wastes containing metals. The wastes are subjected to very hot reducing gas produced from the combustion of solid or gaseous hydrocarbon fuels in oxygen-enriched air. The waste materials react rapidly in the reactor producing a non-leachable slag and a possibly recyclable metal-enriched oxide. Treated slag can possibly be recycled as fill material or road aggregate. Metal-enriched oxide may be recycled to secondary smelting facilities for recovery of metals. The treatment contractor would be responsible for disposal or recycling of treated slag and metal-enriched oxide generated as secondary waste, although at this time, markets have not been identified.

Evaluation

- o Effectiveness: This remedial alternative would achieve all the remedial objectives for the slag and lead oxide material. Complete reduction of the toxicity, mobility and volume of inorganic contaminants would be achieved. There would be little short-term exposure risks to on-site workers and nearby residents because no on-site treatment is involved. However, a short-term impact on neighboring communities may result from the increase of traffic flows and the potential exposure to hazardous waste due to possible accidents and waste spills during transport. This alternative would remove the primary source of contamination which is currently migrating into the environment. Therefore, the beneficial effects include removal of contaminants and elimination of further contamination of surface water, groundwater, soils and air. There are no long-term risks to the public health or the environment because all the contaminated material would be removed from the site. Based on currently available capacity of 3 tons/hour, it would take more than two years to achieve complete protection. This estimate includes design, bidding, contractor selection, mobilization, demobilization and actual remediation time.
- o Implementability: This technology is being tested under EPA's Superfund Innovative Technology Evaluation (SITE) program, which evaluates new and promising hazardous waste cleanup technologies. Although this technology is used for electric arc furnace dust on full scale, it has not been used for CERCLA waste on a full scale basis. The sole vendor envisions a full scale unit for CERCLA waste in one year. No long-term monitoring would be required because the slag and lead oxide material would be completely removed from the site and it would be considered as a permanent remedy. Treated slag would not leach metals and it could possibly be recycled as fill material or road aggregate. Lead would be collected along with other

volatile metals as metal oxide and possibly be recycled although, at this time, no markets have been identified for these materials. If treated materials could not be recycled, it would increase the expense resulting from disposal cost. Permits would be required for transportation of hazardous waste.

- o Cost: The capital cost for this alternative is estimated at \$4,215,100. A separate operation and maintenance cost is not required since capital cost includes all costs. The present worth is same as capital cost.

Conclusion

This alternative would remove contaminated materials from the site and treat it to produce possibly recyclable non-leaching slag and metal enriched oxide. Although a full-scale facility is not available at present, it is anticipated to be available in a year. This alternative is therefore retained for detailed evaluation.

4.2.2.1.4 Alternative SP-4: On-Site Hydro-Metallurgical Leaching/On-Site or Off-Site Disposal

Description

Site preparation for this alternative would include an equipment staging area and support facilities. This would be similar to Alternative SP-2. The hydro-metallurgical leaching process technology is considered as a representative process option for extraction. The process is based on the principles of hydro-metallurgy commonly used for the extraction of metals from ores. This technique uses a hot aqueous caustic leach solution for the extraction of heavy metals from waste residues. The solution can be regenerated after recovery of the dissolved metals for subsequent leaching, thus minimizing reagent costs, reducing the waste volume and generating a marketable product from the existing toxic residues.

Approximately 9,800 cy of slag material and 200 cy of lead oxide and similar material would be removed from existing piles and treated using the hydro-metallurgical leaching process on site. The process selectively dissolves lead and other heavy metals in the slag and lead oxide materials. The leaching step is followed by filtration, which separates and collects the residue. Lead and halide rich leach filtrates then react with metallic aluminum fines to precipitate the lead and other dissolved metals. The precipitate is a lead rich, possibly marketable metallic sponge product. Caustic solution is recycled after replenishment with fresh caustic. Slag and lead oxide materials treated to pass TCLP would be placed on site in accordance with RCRA treatment standards. For cost estimating purposes, it was assumed that the on-site placement would meet RCRA Subtitle D requirements, although the actual disposal requirements would be defined in design, pending treatability studies. Treated material may be transported off site for disposal in a Subtitle D nonhazardous landfill.

If the treated material is disposed of on site, a long-term monitoring program would be instituted to monitor potential migration of contaminants into the environment.

Evaluation

- o Effectiveness: The hydro-metallurgical leaching treatment technology would be expected to produce a residue which would pass TCLP. However, effectiveness of the process is dependent on the ability of caustic solutions to effectively extract oxidic lead and cadmium compounds from the complex residue. To some extent, such solution may not significantly attack the contaminant because of inert material present in the residue. Substantial pilot work would be required to demonstrate its effectiveness. Based on available capacity of 100 cy per day it would take approximately 16 months to achieve complete protection. This estimate includes design, bidding, contractor selection, mobilization, demobilization and actual remediation time.
- o Implementability: This technology is proven for the metallurgical industry and associated process equipment is readily available or can be assembled using off-the-shelf equipment. The components of the treatment process include volumetric feeder, leach tank, process surge tank, filter press, cementation tank, filtrate tanks, polishing filters and spent liquor tank. This process is, however, not demonstrated for similar materials. Slag and lead oxide materials treated to pass TCLP would be placed on site in accordance with RCRA treatment standards or transported off site for disposal in a Subtitle D nonhazardous landfill. The metallic sponge could possibly be recycled for metal recovery. Adequate space is available for Subtitle D landfill to be constructed on site. Off-site nonhazardous landfills are also available for disposal of treated material. However, capacities may be limited. Off-site disposal would not provide any additional protection because treated material would be considered as nonhazardous. Since remediation takes place on a Superfund site, permits would not be required as long as substantive requirements of the permit are satisfied.
- o Cost: The capital costs for this alternative are estimated at \$2,980,400 for on-site disposal and \$3,874,300 for off-site disposal. Separate annual operation and maintenance cost is not required for off-site disposal option since capital cost includes all costs. Annual operation and maintenance costs for the on-site disposal option is estimated at \$17,000. In addition it is estimated to require \$10,000 for each five-year review for the on-site disposal option. Present worth would be same as capital cost for the off-site disposal option. Total present worth for on-site disposal option is estimated at \$3,269,500.

Conclusion

This alternative is expected to provide adequate protection of public health from slag and lead oxide piles. It can also be expected to effectively eliminate the contribution of the site to further surface water and groundwater contamination and air pollution. In addition, this alternative produces possibly recyclable lead. The off-site disposal option does not provide any additional protection because the treated material would be considered nonhazardous. The off-site disposal option would incur higher cost without additional benefits. Therefore it is eliminated from further consideration. This alternative with the on-site disposal option is, however, retained for detailed evaluation.

4.2.2.1.5 Alternative SP-5: On-Site Stabilization (Solidification)/On-Site or Off-Site Disposal

Description

Site preparation for this remedial alternative would include an equipment staging area. Support facilities would also be installed. Approximately 9,800 cy of slag material and 200 cy of lead oxide and similar material would be removed from the existing piles and stabilized on site using a mobile treatment system. The moisture content of the slag and lead oxide material may be adjusted. Stabilizing agents such as cement, pozzolan, silicates and proprietary polymers, or their combination, are mixed with the feed material. The equipment used is similar to that used for cement mixing and handling. It includes a feed system, mixing vessels, and a curing area. Critical parameters in stabilization/solidification include selection of stabilizing agents and other additives, the waste to additive ratio, and mixing and curing conditions. All of these parameters are dependent on the chemical and physical characteristics of the waste. Bench-scale treatability tests would be required to select the proper quantity of additives and to determine the curing time required to set the waste adequately. Leaching tests and compressive strength tests would be required to determine the integrity of the solid end product. Stabilized material treated to pass TCLP would be placed on site in accordance with RCRA treatment standards. For cost estimating purposes, it was assumed that the on-site placement would meet RCRA Subtitle D requirements, although the actual disposal requirements would be defined in design, pending treatability studies. Treated material may be transported off site for final disposal. If treated material is disposed of on site, a long-term monitoring program would be instituted to monitor the potential migration of residual contaminants into the environment.

Evaluation

- o Effectiveness: Stabilization technologies have been most widely successful when applied to metal wastes similar to the slag and lead oxide materials at the NL site. This

remedial alternative would achieve all the remedial objectives for the slag and lead oxide materials. Toxicity of the hazardous constituents of the materials would be reduced in that they would be immobilized in the stabilized mass and no longer present a direct contact threat. This alternative would prevent further contamination by evolution of dust and contaminated runoff and would result in non-leachable materials. The short-term environmental impact of this alternative would be small. There would be some short-term exposure risk to on-site workers during material handling. However, workers would be properly protected in compliance with a site-specific Health and Safety Plan. Long-term reliability of stabilization is not well known. This alternative will bind all metals, including volatile metals. Stabilized material would be placed on site in accordance with RCRA treatment standards or transported off site for disposal in a Subtitle D nonhazardous landfill. The length of time to complete protection is estimated to be fifteen months, based on available capacity of 200 cy per day. This estimate includes design, bidding, contractor selection, mobilization, demobilization and actual remediation time.

- o Implementability: The mobile treatment system required for this alternative is readily available and offered by a number of vendors. This alternative generally results in a volumetric increase up to 50 percent depending on additives used. For this study it is assumed to be 40 percent. In spite of this, the alternative achieves a permanent solution through immobilization and some degree of detoxification. Adequate space is available for Subtitle D landfill to be constructed on site. Off-site nonhazardous landfills are also available for disposal of stabilized material but they would not be more protective and their capacities may be limited. Off-site disposal would not provide any additional protection because treated material would be considered as nonhazardous. Since remediation takes place on a Superfund site, permits would not be required as long as substantive requirements of the permit are satisfied.
- o Cost: The capital cost for this alternative is estimated at \$2,014,000 for on-site disposal and \$3,465,200 for off-site disposal. Separate annual operation and maintenance cost is not required for off-site disposal option since capital cost includes all costs. Annual operation and maintenance cost for on-site disposal is estimated at \$17,000. In addition, it is estimated to require \$10,000 for each five-year review for the on-site disposal option. Present worth for the off-site disposal would be same as capital cost for the off-site disposal option. Total present worth for the on-site disposal option is estimated at \$2,303,100.

Conclusion

This alternative would reduce the mobility of contaminants. Stabilization (solidification) is a well-proven technology for metal contaminants and is readily available from a number of vendors. The off-site disposal option does not provide any additional protection because the treated material would be considered as nonhazardous. Off-site disposal would incur higher costs without additional benefits. Therefore it is eliminated from further consideration. This alternative with the on-site disposal option is, however, retained for detailed evaluation.

4.2.2.1.6 Alternative SP-6: Off-Site Stabilization (Solidification)/Off-Site Disposal

Description

Site preparation for this remedial alternative would be the same as Alternative SP-3. Approximately 9,800 cy of slag material and 200 cy of lead oxide and similar material would be removed from existing piles and loaded onto trucks or rail cars and transported to an off-site RCRA-permitted facility for stabilization/solidification and disposal.

Evaluation

- o Effectiveness: This remedial alternative would achieve all the remedial objectives for the slag and lead oxide piles. Practically complete reduction of the toxicity, mobility and volume of contaminants would be achieved. There would be minimal short-term exposure risk to on-site workers and nearby residents. Similar to Alternative SP-3, waste handling would be conducted under moistened condition to minimize fugitive dust. All site activities would be conducted according to a site-specific Health and Safety Plan. However, a minimal short-term environmental impact on neighboring communities may result from the increase of traffic flows and the potential exposure to hazardous waste due to possible accidents and waste spills during transport. This alternative would remove the primary source of contamination which would prevent further contamination of surface water, groundwater, soils and air. This alternative would also eliminate a direct contact and inhalation pathway. There would be no long-term risks to the public health or the environment because all contaminated material would be removed from the site. The time until protection is achieved is estimated to be approximately one year. This estimate includes design, bidding, contractor selection, mobilization, demobilization and actual remediation time.
- o Implementability: The off-site stabilization/solidification and disposal facilities and support facilities required for this remedial alternative are commercially available, but capacities may be limited and wastes may

have to be transported to a distant facility. No long-term monitoring would be required after completion of this alternative. Transportation of hazardous wastes would require a permit.

- o Cost: The capital cost for this alternative is estimated at \$6,159,100. A separate annual operation and maintenance cost is not included since all costs are included as one time capital cost. The present worth for this alternative is the same as capital cost.

Conclusion

Off-site stabilization/solidification and disposal facilities and capacities available to implement this alternative are limited. Although this alternative would completely remove all contaminants from the site and would be considered a permanent remedy, it involves high cost without additional benefits. Therefore, this alternative is eliminated from detailed evaluation.

4.2.2.1.7 Alternative SP-7: Off-Site Disposal

Description

Site preparation and support facilities for this alternative would be similar to Alternative SP-3. Approximately 9,800 cy of slag material and 200 cy of lead oxide and similar material would be removed from the site, loaded on trucks or rail cars and transported to off-site RCRA permitted Subtitle C landfill for disposal.

Evaluation

- o Effectiveness: This alternative does not use treatment to achieve reduction in toxicity, mobility or volume. It would however achieve reduction in toxicity, mobility and volume of the contaminants at the site by removal of contaminated slag and lead oxide material. Mobility of the contaminants would be reduced by placement of the waste in a properly managed RCRA-permitted Subtitle C landfill. Waste handling would require use of personal protection equipment and would be conducted in accordance with a site-specific Health and Safety Plan. There could be short-term risk to the neighboring community and the environment due to possible accidents during transportation of the waste. However, coordination with local and State traffic authorities would minimize this risk. This alternative would be effective in eliminating contaminant sources, thereby preventing further contamination of surface water, groundwater, soils and air and eliminating health risks. No long-term monitoring would be required for this alternative. Based on available landfill capacity, it is estimated to take approximately one year to achieve complete protection. This estimate includes

design, bidding, contractor selection, mobilization, demobilization and actual remediation time.

- o Implementability: The Land Disposal Restrictions prohibit landfilling of hazardous wastes without treatment. However, contaminated debris may be disposed of without treatment under capacity variance provisions of LDRs until May 8, 1992. Slag and lead oxide piles at the NL site may be considered as D008 waste and may be disposed of in Subtitle C facilities without treatment under national capacity variance provisions of LDR. There should be no special difficulties in removing and transporting the slag and lead oxide material to the landfill. Transportation of hazardous waste would require a permit. The major uncertainty in implementing this alternative is identifying the disposal facilities capable of accepting the waste materials in question and the associated cost of transportation and disposal at the time of remediation. However some facilities are currently identified to implement this alternative. This alternative would not be feasible after expiration of capacity variance provisions of LDR on May 8, 1992.
- o Cost: The capital cost for this alternative is estimated at \$4,795,600. A separate operation and maintenance cost is not included since all costs are included as one time capital cost. The present worth for this alternative is the same as capital cost.

Conclusion

Although LDRs severely restrict landfilling of untreated hazardous wastes, capacity variance provisions of LDRs allow land disposal of D008 waste up to May 8, 1992. This alternative would completely remove waste from the site, thus preventing further contamination of surface water, groundwater, soils and air, and eliminating health risks. This alternative does not reduce toxicity, mobility or volume by treatment. In addition it may not be feasible to implement this alternative by expiration of capacity variance provisions of LDR. This alternative is therefore eliminated from detailed evaluation.

4.2.2.2 Debris and Contaminated Surfaces (Buildings and Equipment) Alternatives

4.2.2.2.1 Alternative CS-1: No Action

Description

The No Action alternative provides the baseline against which other alternatives can be compared. Contaminated debris would be left on site. Contaminated surfaces in the buildings and equipment would be left in their current condition. Due to possible leakage, building roofs would be repaired. No additional security measures would be needed because the buildings are locked and not accessible to unauthorized persons.

A long-term maintenance program would be implemented in order to ensure that the buildings are locked and are not accessible to the public in the future. Five-year reviews would be performed to assess the need for future actions.

Evaluation

- o Effectiveness: The debris and contaminated surfaces at the site pose several imminent hazards to public health and the environment. The No Action alternative would not meet the remedial objectives. This alternative would not reduce the toxicity or volume of the contaminants. However, due to the fact that the buildings are locked, the mobility of the contaminants and associated public health threat is limited. Due to possible leakage, roofs would be repaired. This would also slow down the deterioration of the buildings. This alternative has no short term public health or environmental effects, if the contaminants remain in the buildings. Contaminated debris staged outdoors is susceptible to vandalism. Therefore direct contact, ingestion and inhalation by trespassers or on-site workers are potential exposure pathways. Potential long-term risk exists if the buildings are forced open. This alternative would not render the buildings reusable. Buildings would not be safe for entry without proper protective clothing.

Implementability: Currently, the buildings are locked; therefore this alternative would not require any major immediate action. A number of roofing contractors are locally available to repair the leaking roofs. However, some equipment and debris which are outdoors would need protection from precipitation. Institutional management of a long-term maintenance program for the buildings would be required.

- o Cost: Capital cost for this alternative is estimated to be \$17,700. The operation and maintenance cost is estimated at \$6,800 per year for 30 years. Five-year review costs are estimated at \$5,000 per review. The present worth, calculated on the basis of a discount rate of 5 percent, is \$136,100.

Conclusion

The No Action alternative will be retained for detailed evaluation to provide a baseline against which the other alternative may be compared, as required by CERCLA, as amended.

4.2.2.2.2 Alternative CS-2: Contaminated Surface Decontamination/Off-Site Treatment and Disposal

Description

The contaminated surfaces of the buildings (i.e., walls, floors, ceiling) and equipment surfaces would be decontaminated using

dusting, vacuuming and wiping procedures. Parts of the buildings which can withstand high water pressure and paved surfaces would be cleaned by hydroblasting. In addition contaminated debris would be decontaminated by dusting, vacuuming, wiping or hydroblasting and sent off-site for disposal. Any recyclable materials would be recycled. Any debris that could not be decontaminated would be disposed of in a Subtitle C facility. The collected dust would be transported to an off-site RCRA permitted facility for treatment and disposal. Contaminated water resulting from decontamination procedures would be treated and/or disposed of with the standing water.

Evaluation

- o Effectiveness: This remedial alternative would meet the remedial objectives for the debris and contaminated surfaces. All the contaminated dust, and debris would be removed from the site so that it poses no chemical threat to human health and the environment.

The only significant threats to public health are short-term exposure of on-site workers to the contaminated dust and water during the building decontamination and handling of debris. Long-term exposure to these contaminants would be eliminated. Other short-term hazards to neighboring facilities and communities include exposure to the hazardous waste (dust and debris) due to possible accidents, and waste spills during transport. This alternative would require approximately one year to achieve complete protection.

- o Implementability: The equipment, technologies and materials required for dust and debris removal and disposal are commercially available and reliable. Effectiveness of dust and debris removal can be easily determined by post remediation sampling.
- o Cost: The capital cost for this alternative is estimated at \$1,691,100. No additional operating and maintenance cost is needed. The present worth for this alternative is the same as the capital cost.

Conclusion

This remedial alternative would meet the remedial objectives for debris and contaminated surfaces. The equipment, technologies and materials required for this alternative are readily available. This alternative would therefore be retained for detailed evaluation.

4.2.2.3 Standing Water and Sediment Alternatives

4.2.2.3.1 Alternative SW-1: No Action

Description

The No Action alternative provides the baseline case for comparison with other standing water and sediment remedial alternatives. In this alternative, the contaminated standing water and sediment is left to natural attenuation without any treatment. Surface water and groundwater monitoring programs would be instituted to monitor migration of contaminants from standing water. Regular five-year reviews would be performed to assess the need for additional remedial actions. In addition, public education programs would be implemented to inform the public about potential hazards.

Evaluation

- o Effectiveness: At the present time, the ponded areas and the basement of the refining building contain water contaminated with high levels of lead and other metals. Water that migrates off-site could pose a serious threat to public health and the environment. This alternative would not involve treatment and therefore would not achieve any immediate reduction in toxicity, mobility or volume if contaminated standing water remains on the site and runoff from these areas continues. The contaminant concentrations in the standing water can gradually increase if the slag and lead oxide piles, and other contaminated materials are left on site. The volume of standing water and sediments may fluctuate. It is estimated to take well in excess of 30 years for natural attenuation to achieve protection. For costing purposes a 30-year period will be used. This alternative would not address the contaminant-specific ARARs.
- o Implementability: This No Action alternative can be easily implemented since it involves no major construction. The technologies associated with monitoring activities are well developed, reliable and readily available. Existing groundwater monitoring wells would be used for long-term groundwater monitoring. However, an institutional management program would be required to manage the long-term monitoring program. Public education programs and five-year reviews are easy to implement.
- o Costs: This alternative would not require any construction and therefore would not incur any capital cost. Annual operation and maintenance costs for this alternative is estimated to be \$10,700. In addition, each five-year review cost is estimated to be \$20,000. The present worth, calculated on the basis of a 5 percent discount rate for 30 years, is \$220,100.

Conclusion

Although the No Action alternative does not meet remedial objectives, it will be retained for detailed evaluation, as it is required by CERCLA as amended to serve primarily as the baseline against which the other alternatives can be compared.

4.2.2.3.2 Alternative SW-2: On-Site Treatment and Groundwater Recharge

In this alternative, approximately one million gallons of standing water and water used for decontamination would be pumped at a rate of 20 gpm to an on-site collection and treatment facility. The treated water would be recharged to groundwater through injection wells or temporary recharge basins. Approximately 200 cy of sediments underlying the standing water would be removed, dewatered and treated/disposed of off-site. Plugged drains would be unplugged and decontaminated.

The treatment system would be designed to reduce the metal concentrations in the standing water to meet Federal and New Jersey discharge standards. This treatment system would consist of a metal precipitation system, lamella type clarifier and dual media pressure filter and sludge and sediment handling system. Ion exchange or ion replacement processes may be used as polishing steps if necessary. The resulting dewatered sludge and sediments would require off-site treatment and disposal.

Treated water discharge would be monitored to confirm compliance with the discharge requirements. Treatment plant performance would be routinely monitored to assess the effectiveness of remediation.

Evaluation

- o Effectiveness: Alternative SW-2 would reduce the levels of metal contaminants of concern in the standing water to the Federal and State levels required for discharge. This alternative would prevent further migration of the contaminants into surface water and groundwater. Therefore the remedial objectives would be met. The treatment technologies proposed for this alternative are proven technologies and have been widely used in the removal of metals from water.

The short-term threat to on-site workers from exposure to contaminated water is minimal. There is no long-term threat to the environment and public health, since this alternative provides for remediation of the contaminated water to contaminant levels that are health protective. Since the treated water would meet all contaminant-specific ARARs, no adverse impacts on the environment would

result. This alternative would require approximately 14 months to achieve complete protection. This estimate includes design, bidding, contractor selection, mobilization, demobilization and actual remediation time.

- o Implementability: The unit operations of metal precipitation for removal of metals from standing water are well-developed technologies and commercially available. Mobile treatment systems are available for on-site treatment. Sludge generated in the treatment system, along with sediments removed from the site, would require off-site treatment and disposal. Since remediation takes place on a Superfund site, permits would not be required as long as substantive requirements of the permit are met.
- o Cost: The capital cost for this alternative is estimated to be \$1,335,000. No operation and maintenance cost would be required since the capital cost includes all costs. Present worth is the same as capital cost.

Conclusion

This remedial alternative would adequately address the remedial response objectives by employing the best demonstrated available technologies (BDAT) to remove contaminants from the standing water. Therefore, this alternative is retained for detailed evaluation.

4.2.2.3.3 Alternative SW-3: Off-Site Treatment and Disposal

Description

Contaminated standing water and sediments would be pumped and collected in tanker trucks or rail cars and transported to a RCRA permitted treatment storage and disposal facility. Plugged drains would be unplugged and decontaminated.

Evaluation

- o Effectiveness: This alternative would be effective because it removes all the contaminated standing water and sediments from the site. This remedial alternative would achieve all the remedial objectives for the contaminated standing water. It would prevent further migration of contaminants to surface waters and groundwater. It would also eliminate the exposure risk to site workers and trespassers. There would be some short-term exposure risk to on-site workers; however, workers would be properly protected in compliance with a site-specific Health and Safety Plan. There could also be short-term risk from potential accidents and spills on transportation routes. This alternative would require approximately six months to achieve complete protection. This estimate includes design, bidding, contractor selection, mobilization, demobilization, and actual remediation time.

- o Implementability: The off-site treatment, storage and disposal facility required for contaminated standing water is available. Once the remediation is completed, there would be no need for operation and maintenance because all contaminated water would be removed from the site, resulting in a permanent remedy. Transportation of contaminated water would require a permit. The site is accessible by trucks and rail.
- o Cost: The capital cost for this alternative is estimated at \$993,200. A separate annual operation and maintenance cost is not required since capital cost includes all costs. Present worth would be same as capital cost.

Conclusion

This alternative would adequately address the remedial response objectives by removing and disposing of contaminated standing water at an off-site RCRA permitted treatment and disposal facility. This alternative is therefore retained for detailed evaluation.

4.2.3 Summary

Tables 4-11, 4-12 and 4-13 summarize the results of the screening of the interim remedial alternatives for the NL site. Alternatives that passed the initial screening were retained and further evaluated in Section 5.0.

TABLE 4-11

SUMMARY OF REMEDIAL ALTERNATIVE SCREENING FOR SLAG AND LEAD OXIDE MATERIALS

REMEDIAL ALTERNATIVES	EFFECTIVENESS	IMPLEMENTABILITY	Capital	COST	Present	STATUS
			Cost (\$)	Annual O&M (\$)	Worth (\$)	
SP-1: No Action	<ul style="list-style-type: none"> - Does not achieve remedial objectives for slag and lead oxide materials - Does not reduce the toxicity, mobility or volume of contaminants - Does not reduce short-term or long-term risk from direct contact, ingestion and inhalation of contaminants - Does not prevent further contamination of surface water, groundwater and air 	<ul style="list-style-type: none"> - Easily implemented - Institutional management required for long-term monitoring 	0	25,000	439,900*	Retained for detailed evaluation to serve as the baseline case as required by CERCLA, as amended
SP-2: On-site Vitrification/ On-Site or Off- Site Disposal	<ul style="list-style-type: none"> - Achieves remedial objectives for slag and lead oxide materials - Reduces toxicity, mobility and volume of contaminants - Short-term exposure risk to workers during remediation period - Prevents further contamination of surface water, groundwater and air - Would not be effective in stabilizing volatile metals and would require complex air pollution control equipments 	<ul style="list-style-type: none"> - Mobile units are available for on-site treatment - Requires high electric power - Would require special power connections - Requires complex air pollution control equipment - No long-term monitoring required for off-site disposal but requires long-term monitoring for on-site disposal 	4,920,000 (on-site disposal) or 5,927,200 (off-site disposal)	17,0000 (on-site disposal) or 0 (off-site disposal)	5,209,100** (on-site disposal) or 5,927,200 (off-site disposal)	Eliminated from detailed evaluation due to its ineffectiveness in treating volatile metals and high cost
SP-3: Off-site Flame Reactor	<ul style="list-style-type: none"> - Achieves remedial objectives for slag and lead oxide materials - Reduces toxicity, mobility and volume of contaminants - Short-term exposure risk to workers and community during handling and transportation 	<ul style="list-style-type: none"> - Innovative technology currently being tested for CERCLA waste - Full-scale treatment unit not available currently - Proven for electric arc furnace dust 	4,215,100	0	4,215,100	Retained for detailed evaluation because it achieves remedial objectives and possibly recycles treated material

* Includes \$20,000 for each five-year review

** Includes \$10, for each five-year review

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TABLE 4-11 (Cont'd)

SUMMARY OF REMEDIAL ALTERNATIVE SCREENING FOR SLAG AND LEAD OXIDE MATERIALS

REMEDIAL ALTERNATIVES	EFFECTIVENESS	IMPLEMENTABILITY	COST			STATUS
			Capital Cost (\$)	Annual O&M (\$)	Present Worth (\$)	
SP-3 (Cont'd)	<ul style="list-style-type: none"> - Prevents further contamination of surface water, groundwater, and air - Possibly recycles treated slag and metal oxides - Does not require long-term monitoring 					
SP-4 On-site Hydro-Metallurgical Leaching/On-site or Off-Site Disposal	<ul style="list-style-type: none"> - Achieves remedial objectives for slag and lead oxide materials - Reduces toxicity, mobility, and volume of contaminants - Short-term exposure risk to workers during re-mediation period - Prevents further contamination of surface water, groundwater and air - Results in recovery and possible recycle of lead - Off-site disposal option does not provide additional protection compared to on-site disposal option. 	<ul style="list-style-type: none"> - Mobile unit is available for on-site treatment - Proven technology for metallurgical industry - Pilot test required - No long-term monitoring required for off-site disposal but would require long-term monitoring for on-site disposal option 	2,980,400 (on-site disposal) or 3,874,300 (off-site disposal)	17,000.00 (on-site disposal) or 0 (off-site disposal)	3,269,500* (on-site disposal) or 3,874,300 (off-site disposal)	Retained on-site disposal for detailed evaluation because it achieves remedial objectives, is proven in metallurgical industry and results in recycling of lead. Eliminated off-site disposal because it provides no additional protection, and costs more than on-site disposal.
SP-5: On-site Stabilization (Solidification)/On-site or Off-site Disposal	<ul style="list-style-type: none"> - Achieves remedial objectives for slag and lead oxide materials - Toxicity of the hazardous constituents would be reduced because stabilized materials no longer present a direct contact threat. Volume may increase depending of specific chemicals and process used - Short-term exposure risk to workers during waste handling and treatment - Prevents further contamination of surface water, groundwater and air 	<ul style="list-style-type: none"> - A number of vendors are available for competitive bid - Widely used for metal contaminants - Mobile treatment units available - Treatability test would be required to optimize operating parameters - No long-term monitoring required for off-site disposal but would require long-term monitoring for on-site disposal option 	2,014,000 (on-site disposal) or 3,465,200 (off-site disposal)	17,000.00 (on-site disposal) or 0 (off-site disposal)	2,303,100* (on-site disposal) or 3,465,200 (off-site disposal)	Retained on-site disposal for detailed evaluation because it achieves remedial objectives and due to the fact that stabilization (solidification) is proven technology for metal contaminants. Eliminated off-site disposal because it provides no additional protection and costs more than on-site disposal.

* Includes \$10,000 for each five-year review.

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TABLE 4-11 (Cont'd)

SUMMARY OF REMEDIAL ALTERNATIVE SCREENING FOR SLAG AND LEAD OXIDE MATERIALS

REMEDIAL ALTERNATIVES	EFFECTIVENESS	IMPLEMENTABILITY	COST			STATUS
			Capital Cost (\$)	Annual O&M (\$)	Present Worth (\$)	
SP-5 (Cont'd)	<ul style="list-style-type: none"> - May require long-term monitoring for on-site disposal but not for off-site disposal - Off-site disposal option does not provide additional protection compared to on-site disposal option. 					
SP-6: Off-site Stabilization (Solidification) / Off-site Disposal	<ul style="list-style-type: none"> - Achieves all remedial objectives for slag and lead oxide materials - Reduces toxicity, mobility and volume of contaminants - Short-term exposure risk to workers and community during handling and transportation - Prevents further contamination of surface water, groundwater and air - Does not require long-term monitoring 	<ul style="list-style-type: none"> - Off-site solidification/stabilization and disposal facilities are available but capacities are limited and may require long distance transportation - Widely used for metal contaminants 	6,159,100	0	6,159,100	Eliminated from detailed evaluation because off-site stabilization/solidification facilities have limited capacities, and it would involve higher cost without any additional protection.
SP-7: Off-Site Disposal	<ul style="list-style-type: none"> - Achieves remedial objectives for slag and lead oxide materials - Reduces toxicity, mobility and volume of contaminants but not by treatment - Short-term exposure risk to workers during handling and transportation - Prevents further contamination of surface water, groundwater and air. - No long-term monitoring required. 	<ul style="list-style-type: none"> - Feasible until May 8, 1992 under national capacity variance provisions of LDR; may not be practicable to implement by this date. - Very few facilities would accept untreated waste for disposal 	4,795,600	0	4,795,600	Eliminated from detailed evaluation because this alternative does not achieve reduction in toxicity, mobility and volume by treatment. In addition it may not be practicable to implement this alternative by expiration of capacity variance provisions of LDR.

TABLE 4-12

SUMMARY OF REMEDIAL ALTERNATIVE SCREENING FOR DEBRIS AND CONTAMINATED SURFACES

REMEDIAL ALTERNATIVES	EFFECTIVENESS	IMPLEMENTABILITY	Capital	COST	Present	STATUS
			Cost (\$)	Annual O&M (\$)	Worth (\$)	
CS-1: No Action	<ul style="list-style-type: none"> - Does not achieve the remedial objectives for debris and contaminated surfaces - Does not reduce toxicity or volume - Mobility is reduced since buildings would be locked - No short-term public health risk if building security is maintained - Buildings can not be reused or entered safely without protective clothing. - Buildings may further deteriorate over time 	<ul style="list-style-type: none"> - Easily implemented. - Long-term building maintenance required 	17,700	6,800	136,100*	Retained for detailed evaluation to serve as the baseline case as required by CERCLA, as amended
CS-2: Contaminated Surfaces Decontamination/Off-Site Treatment and Disposal	<ul style="list-style-type: none"> - Achieves remedial objectives for debris and contaminated surfaces - Reduces toxicity, mobility and volume - Buildings could be entered safely - Short-term exposure risk to workers during decontamination - No long-term risk to the public or the environment 	<ul style="list-style-type: none"> - Equipment and materials easily available - Requires multiple technologies depending on the area to be decontaminated - Off-site facilities available for treatment and disposal of dust and debris - Effectiveness measured by post remediation sampling. - Debris which could not be decontaminated would be disposed of in off-site RCRA facility. 	1,691,100	0	1,691,100	Retained for further evaluation because it achieves remedial objectives

* Includes \$5,000 for each five-year review.

4878K

TABLE 4-13

SUMMARY OF REMEDIAL ALTERNATIVE SCREENING FOR STANDING WATER AND SEDIMENTS

REMEDIAL ALTERNATIVES	EFFECTIVENESS	IMPLEMENTABILITY	COST			STATUS
			Capital Cost (\$)	Annual O&M (\$)	Present Worth (\$)	
SW-1: No Action	<ul style="list-style-type: none"> - Does not achieve clean-up objectives for standing water and sediments - No immediate reduction in toxicity, mobility or volume - Requires long period of time for natural attenuation. 	<ul style="list-style-type: none"> - Easy to implement - Monitoring technologies are available - Long-term monitoring and five-year performance reviews are required 	0	10,700	220,100*	Retained for detailed evaluation to serve as the baseline case as required by CERCLA as amended
SW-2: On-Site Treatment and Groundwater Discharge	<ul style="list-style-type: none"> - Achieves remedial objectives for standing water and sediments - Reduces toxicity, mobility and volume of contaminants - Treated water is expected to meet Federal and State groundwater standards - Prevents further contamination of surface water and groundwater. 	<ul style="list-style-type: none"> - Technologies are proven and available - Off-site treatment and disposal facilities for sludge and sediments are available. - Would not require permits but must meet substantive requirements of the permits. 	1,335,000	0.00	1,335,000	Retained for detailed evaluation because it achieves remedial objectives
SW-3: Off-site Treatment and Disposal	<ul style="list-style-type: none"> - Achieves remedial objectives for standing water - Reduces toxicity, mobility and volume - Prevents further contamination of surface water and groundwater 	<ul style="list-style-type: none"> - Off-site treatment and disposal facility available 	993,200	0.00	993,200	Retained for detailed evaluation because it achieves remedial objectives

5.0 DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

This section presents a detailed description and evaluation of each remedial alternative that passed the initial screening in Section 4.0. The remedial alternatives are examined with respect to the requirements stipulated in CERCLA as amended, "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA" (April 1989), "Guidance for Decontaminating Buildings, Structures and Equipment at Superfund Sites" (March 1985) and "Technology Screening Guide for Treatment of CERCLA Soils and Sludges" (September 1988). Section 5.1 discusses the evaluation processes used and the nine criteria against which the remedial actions are analyzed. Sections 5.2, 5.3 and 5.4 describe the alternatives in detail and evaluate each with respect to the evaluation criteria. Section 5.5 presents a comparison of the remedial alternatives.

5.1 EVALUATION PROCESSES

A detailed analysis of the remedial alternatives consists of the following components and processes:

- o Further definitions of each alternative, if appropriate, with respect to the volumes and areas of contaminated media to be addressed, the technologies to be used, and any performance requirements associated with those technologies.
- o Assessment and summary of each alternative against the nine criteria as defined by the RI/FS Guidance document.
- o Comparative analysis among the remedial alternatives to assess the relative performance of each alternative with respect to each evaluation criterion.

Based on the statutory preferences and the response objectives developed in Section 4.0, remedial alternatives shall meet the following requirements during evaluation and selection:

- o Protection of human health and the environment (CERCLA Section 121(b)).
- o Attainment of the applicable or relevant and appropriate requirements (ARARs) of Federal and State laws (CERCLA Section 121(d)(2)(A)) or warranting a waiver under CERCLA Section 121(d)(4).
- o Reflection of a cost-effective solution, taking into consideration short- and long-term costs (CERCLA Section 121(a)).
- o Use of permanent solutions and treatment technologies or resource recovery technologies to the maximum extent practicable (CERCLA Section 121(b)).

- o Satisfaction of the preference for remedies that employ treatments that permanently and significantly reduce the toxicity, mobility, or volume of hazardous substances as a principal element, or explanation of reasons why such remedies were not selected (CERCLA Section 121(b)).

In order to address the CERCLA requirements adequately, nine evaluation criteria have been developed. These criteria are discussed and defined in the EPA Guidance for Conducting RI/FS under CERCLA (Final, April 1989).

The first two criteria are the "threshold" factors. Any alternative that does not satisfy both of these criteria is dropped from further consideration in the detailed analysis. These are:

1. Overall protection of human health and the environment
2. Compliance with applicable or relevant and appropriate requirements (ARARs)

Five "primary balancing" criteria are used to make comparisons and to identify the major trade-offs between the remedial alternatives. Alternatives that satisfy the threshold criteria are evaluated further using the following balancing criteria:

3. Long-term effectiveness
4. Reduction of toxicity, mobility or volume through treatment
5. Short-term effectiveness
6. Implementability
7. Cost

The remaining two criteria, State acceptance and community acceptance, are "modifying" factors. State acceptance will be evaluated in the Proposed Plan after receiving State comments on this Focused Feasibility Study report. The Proposed Plan will identify the remedial alternative preferred by EPA and NJDEP. The final evaluation criterion, community acceptance, will be evaluated in the Record of Decision (ROD) after the public comment period is completed.

A discussion of the nine evaluation criteria is presented below. Then, each remedial alternative is evaluated with respect to the first seven criteria. At the completion of all detailed analyses, a summary section is included, wherein the statutory factors and criteria are compared for each remedial alternative to facilitate the remedy selection process.

Overall Protection of Human Health and the Environment

This evaluation criterion provides an overall assessment of protection based on a composite of factors such as long-term and short-term effectiveness and compliance with ARARs. Evaluations of the overall protectiveness address:

- o How a specific site remedial action achieves protection over time;
- o How site risks are reduced; and
- o How each source of contamination is to be eliminated, reduced, or controlled for each remedial alternative.

Compliance with ARARs

This evaluation criterion is used to determine how each remedial alternative complies with applicable or relevant and appropriate Federal and State requirements as defined in CERCLA Section 121. Each alternative is evaluated in detail for:

- o Compliance with contaminant-specific ARARs (e.g., RCRA Standards);
- o Compliance with action-specific ARARs (e.g., RCRA minimum technology standards);
- o Compliance with location-specific ARARs (e.g., preservation of historic sites); and
- o Compliance with appropriate criteria, advisories, and guidances (i.e., "To Be Considered" material).

Section 4.0 presents an overall list of ARARs and "To Be Considered" (TBC) material that were used to evaluate the remedial alternatives. Specific statutory or regulatory citations and their applications to the remedial alternative evaluations are contained in Sections 5.2, 5.3 and 5.4.

Long-Term Effectiveness

This evaluation criterion addresses the results of the remedial action in terms of the risk remaining at the site after the response objectives have been met. The components of this criterion include the magnitude of the remaining risks measured by numerical standards such as cancer risk levels; the adequacy and suitability of controls used to manage treatment residuals or untreated wastes; and the long-term reliability of management

controls for providing continued protection from residuals (i.e., the assessment of potential failure of the technical components).

Reduction of Toxicity, Mobility or Volume Through Treatment

This evaluation criterion addresses the statutory preference that treatment results in the reduction of principal threats of the total mass of toxic contaminants, the irreversible reduction in contaminant mobility, or the reduction of the total volume of contaminated media. Factors to be evaluated in this criterion include the treatment process employed; the amount of hazardous material destroyed or treated; the degree of reduction in toxicity, mobility, or volume expected; and the type and quantity of treatment residuals.

Short-Term Effectiveness

This evaluation criterion addresses the impacts of the remedial action during the construction and implementation phases preceding the attainment of the remedial response objectives. Factors to be evaluated include protection of the community during the remedial actions, protection of workers during the remedial actions, environmental impacts resulting from the implementation of the remedial actions, and the time required to achieve protection.

Implementability

This criterion addresses the technical and administrative feasibility of implementing a remedial action and the availability of various services and materials required during its implementation. Technical feasibility factors include construction and operation difficulties, reliability of technology, ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of the remedy. The administrative feasibility includes the ability and time required for permit approval and for activities needed to coordinate with other agencies. Factors employed in evaluating the availability of services and materials include availability of treatment, storage, and disposal services with required capacities; availability of equipment and specialists; and availability of prospective technologies for competitive bidding.

Cost

The types of costs that would be addressed include: capital costs, operation and maintenance (O&M) costs, costs of five-year reviews where required, present value of capital and O&M costs, and potential future remedial action costs. Capital costs consist of direct and indirect costs. Direct costs include expenditures for the equipment, labor, and materials necessary

to install remedial actions. Indirect costs include expenditures for engineering, financial, and other services required to complete the installation of remedial alternatives. Other annual O&M costs include auxiliary materials and energy, disposal of residues, purchased services, administrative costs, insurance, taxes, license costs, maintenance reserve and contingency funds, rehabilitation costs, and costs for periodic site review.

This assessment evaluates the costs of the remedial actions on the basis of present worth. Present worth analysis allows remedial alternatives to be compared on the basis of a single cost representing an amount that, if invested in the base year and disbursed as needed, would be sufficient to cover all costs associated with the remedial alternative over its planned life. A required operating performance period is assumed for present worth and is a function of the discount rate and time. A discount rate of five percent is assumed for a base calculation. The "study estimate" costs provided for the remedial actions are intended to reflect actual costs with an accuracy of -30 to +50 percent.

State Acceptance

This assessment evaluates the technical and administrative issues and concerns the State may have regarding each of the remedial alternatives. The factors to be evaluated include features of the actions that the State supports, has reservations about, or opposes.

Community Acceptance

This assessment incorporates public input into the analysis of the remedial alternatives. Factors of community acceptance to be discussed include features of the supportiveness, reservations and opposition of the community.

The breakdown of major facilities and construction components for the remedial alternatives, and the detailed breakdown of capital and annual operation and maintenance cost estimates are presented in Appendices A and B, respectively.

5.2 ALTERNATIVE ANALYSIS FOR SLAG AND LEAD OXIDE PILES (SP)

The slag and lead oxide pile remedial alternatives that passed the initial screening process in Section 4.0 and will be evaluated further in detail against the seven evaluation criteria are as follows:

- o Alternative SP-1: No Action
- o Alternative SP-3: Off-Site Flame Reactor
- o Alternative SP-4: On-Site Hydro-Metallurgical Leaching/On-Site Disposal

o Alternative SP-5: On-Site Stabilization (Solidification)/On-Site Disposal

A detailed description and discussion of the above remedial alternatives for slag and lead oxide piles is presented in the following subsections.

5.2.1 Alternative SP-1: No Action

5.2.1.1 Description

The No Action alternative for the slag and lead oxide material at the NL site consists of a long-term monitoring program. Groundwater, surface water and soil in and around the site would be monitored annually. Groundwater would be monitored by using the existing wells. Surface water would be monitored by sampling the West Stream and the East Stream.

The no action alternative also includes the development and maintenance of a public awareness and education program for the residents and workers in the area surrounding the NL site. This program would include the preparation and distribution of informational press releases and circulars and the convening of public meetings. These activities would also require the involvement of local government, and various health departments and environmental agencies.

Because this alternative does not include contaminant removal, the site would have to be reviewed every five years for a period of 30 years as required by CERCLA as amended. These five-year reviews would include the assessment of human health and environmental risks due to the contaminated slag and lead oxide materials left on site, using data obtained from the sampling program.

5.2.1.2 Assessment

Overall Protection of Human Health and the Environment

The No Action alternative would not remove or contain the contaminated slag and lead oxide materials, and therefore, it would not be protective of human health and the environment due to the continued migration of contaminants from the slag and lead oxide materials to the surface water, groundwater and air. It would take many years for natural attenuation to reduce the toxicity and volume of contaminated slag and lead oxide materials to levels which would be protective both of human health and of the environment. The toxicity and volume of contaminants would be reduced only by transferring them to surface water, groundwater, soils and sediments. The mobility of the contaminants would remain unchanged. This alternative does not meet any of the remedial response objectives.

Compliance With ARARs

This alternative fails to eliminate the source of contamination. The contaminant-specific ARARs are not satisfied because contaminated slag and lead oxide materials would continue to be released into the environment. The only action-specific ARARs associated with this alternative are the RCRA groundwater monitoring requirements. It is assumed that they would be followed. This alternative would not impact the location-specific ARARs identified in Table 4-9.

Long-Term Effectiveness

The qualitative risk assessment indicates that there is a current and future risk due to contact with, ingestion of, and inhalation of the slag and lead oxide materials. The contaminants of particular concern are heavy metals, due to their prevalence, high concentrations and high toxic or carcinogenic potency. Because contaminated slag and lead oxide materials would be left at the site, this alternative would not meet the remedial objectives.

The No Action alternative would slowly reduce the level of contaminants by natural leaching and migration. However, natural attenuation is a very slow process, especially for metals. Therefore, it would take an unpredictably long period of time to achieve the remedial objectives for the site. Leached contaminants would migrate to surface water, groundwater, soils and sediments.

The implementation of this alternative would not have any additional beneficial effects on the environment. However, potential long-term adverse environmental impacts do exist because the contaminated materials would remain on-site. The potential for contaminant migration from slag and lead oxide piles into groundwater and surface water through leaching and release to air through wind erosion remains. The long-term monitoring program would be an effective method for monitoring the trend of contaminant migration.

Reduction of Toxicity, Mobility or Volume Through Treatment

This alternative does not involve any containment, removal, treatment or disposal actions for contaminated slag and lead oxide materials. It would leave the contaminated materials intact. There is a very slow and gradual reduction of the toxicity and volume of the contaminants due to natural flushing by rain water. However, the time needed to reach the acceptable risk levels is unknown. In addition, the mobility of the contaminants would remain unchanged and therefore, the potential to contaminate the surface water, groundwater and air in the future would remain unchanged.

Short-Term Effectiveness

This alternative would only continue the monitoring of site conditions, specifically the migration of contaminants from slag and lead oxide materials into the groundwater, surface water and air. It will not achieve any of the remedial action objectives. No major construction would be involved in this remedial action, therefore, there are no short-term threats to neighboring communities and no significant impacts on public health and the environment during implementation activities. A minor potential exists for the monitoring crew to contact contaminated slag and lead oxide material during the sampling. However, these risks would be minimized by following site-specific Health and Safety Plan. Monitoring programs and institutional programs could be instituted in approximately three months. It would take more than 30 years to achieve complete protection. However, a period of 30 years would be used for cost estimation purposes.

Implementability

o Technical Feasibility

The monitoring program designed for this site using existing wells, surface water and soil sampling would be easily implemented and would be effective at monitoring contaminant migration from the slag and lead oxide materials into the surface water and groundwater. The public awareness program, consisting of mailing printed notices to advise all private residences, businesses, and public agencies of the status of the site and convening public meetings, could be easily implemented.

o Administrative Feasibility

Considerable long-term institutional management would be associated with this alternative, for the groundwater, surface water and air monitoring program and the five-year reviews. In addition, the development and performance of the monitoring program would necessitate the involvement of environmental and public health agencies, including EPA and New Jersey Department of Environmental Protection (NJDEP).

o Availability of Services and Materials

This alternative does not involve any treatment, storage or disposal services. Equipment and specialists for sampling, monitoring and analysis are locally available and more than one vendor is available for competitive bids.

Cost

This alternative would not involve any construction activity and therefore would not incur any capital cost. The annual operation and maintenance cost is estimated to be \$25,000. In addition, approximately \$20,000 would be required for each five-

year review. The total present worth, calculated on the basis of a discount rate of 5 percent and a 30-year period, is \$439,900. Data in support of the cost estimates are presented in Table A-1 of Appendix A and Tables B-1 and B-10 of Appendix B.

5.2.2 Alternative SP-3: Off-Site Flame Reactor

5.2.2.1 Description

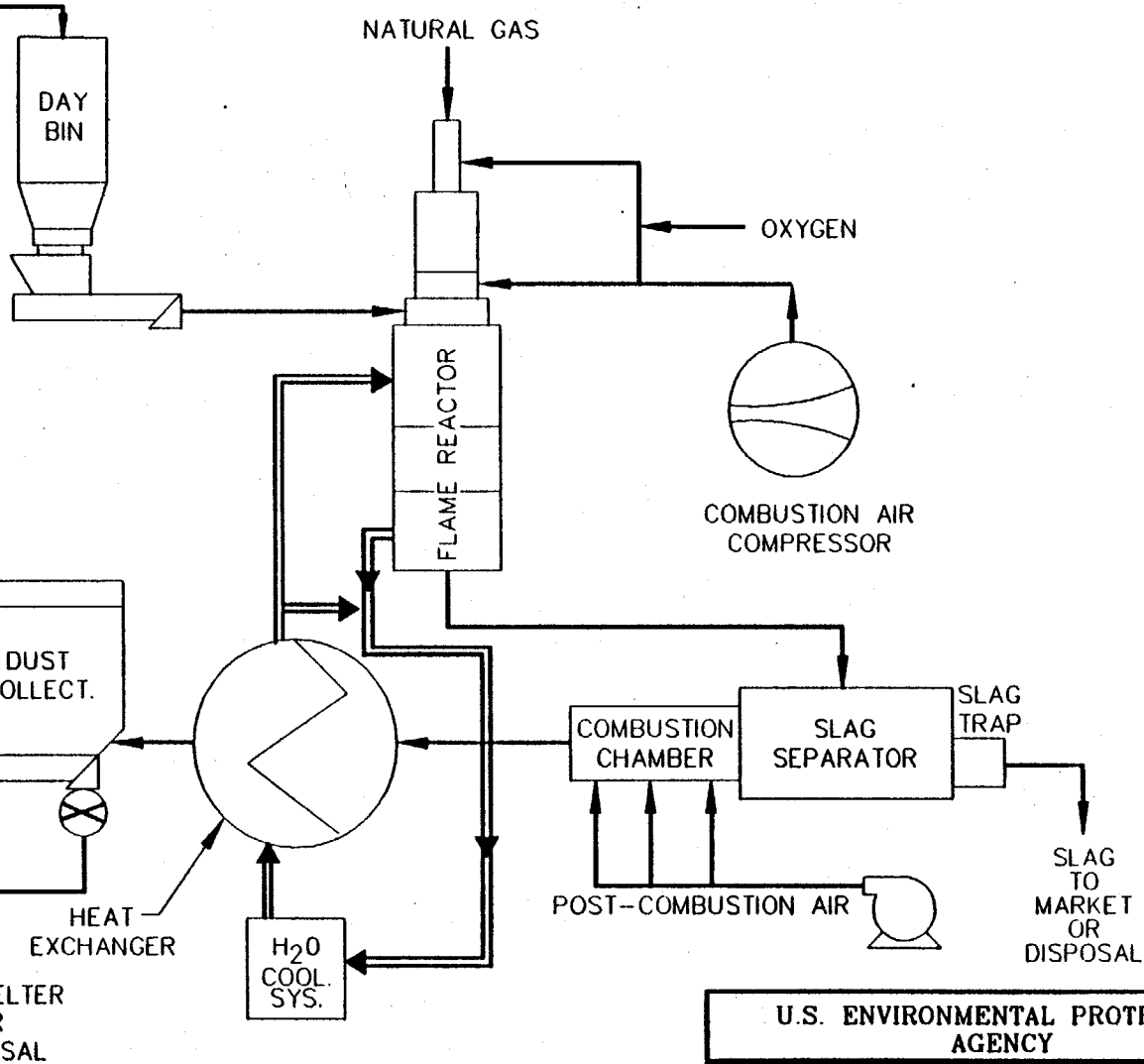
This alternative consists of establishing equipment and support facilities and removal of approximately 9,800 cy of slag material in four separate piles and 200 cy lead oxide material including lead-bearing materials in the debris from the manufacturing area of the NL site. These materials would then be transported to a RCRA-permitted Flame Reactor facility for treatment and possibly recycling.

Off-Site Flame Reactor

Removal of slag and lead oxide materials would be accomplished by use of earth moving equipment such as a backhoe and a front end loader. Materials would be packed in DOT-approved containers or super sacks and loaded onto trucks or rail cars and transported to an off-site RCRA-permitted treatment facility using Flame Reactor technology. Treated materials would then be recycled, if possible.

Flame Reactor technology is a patented process primarily designed to treat residues and wastes containing metals. Figure 5-1 shows a schematic diagram for the Flame Reactor process. In the reactor, wastes are subjected to very hot reducing gas (greater than 2,000°C) produced from the combustion of solid or gaseous hydrocarbon fuels in oxygen-enriched air. In the reactor, the waste materials react rapidly, producing a non-leachable slag (resembling glass when cooled) and a recyclable, metal enriched oxide. The volume of waste reduced to slag depends on the chemical and physical properties of the waste. During processing, the waste material is transferred to the hottest portion of the Flame Reactor, where the volatile metals in the waste are fumed. Due to elevated temperatures in the Flame Reactor, the organic compounds in waste, if any, are destroyed. After post combustion and cooling, the metals are captured in a product collection system. When cooled, the resulting metal oxides are recycled to recover the metals. The nonvolatile metals are encapsulated in the slag, which exists in the reactor. After testing to ascertain that the slag is nonhazardous, it would possibly be recycled as clean fill material or road aggregate.

SLAG AND LEAD
OXIDE MATERIALS
INCLUDING OTHER
LEAD BEARING
MATERIALS



U.S. ENVIRONMENTAL PROTECTION
AGENCY

N.L. INDUSTRIES SITE

FIGURE 5-1

ALTERNATIVE SP-3
FLAME REACTOR PROCESS FLOW
SCHEMATIC DIAGRAM

EBASCO SERVICES INCORPORATED

NLD 001 0441

5.2.2.2 Assessment

Overall Protection of Human Health and the Environment

The removal of contaminated slag and lead oxide materials from the site would significantly reduce the potential human health risks associated with direct contact with contaminated materials and inhalation of airborne particulates, and prevent leaching of contaminants into surface water and groundwater.

This alternative involves treatment which would reduce the toxicity, mobility and volume of hazardous contaminants in the slag and lead oxide materials. No secondary waste management would be required on site except for some decontamination water from the cleaning of equipment and personnel. Treated slag would possibly be recycled as fill material or road aggregate. Metal oxides would possibly be recycled to secondary smelter for metal recovery, however at this time, markets are not identified. This alternative would result in a permanent remedy for the site and overall protection of human health and the environment.

Compliance with ARARs

This alternative will meet all associated ARARs identified. It will meet the contaminant-specific ARARs identified in Table 4-7 by removing contaminated material from the site. The removal activities will be conducted in accordance with OSHA standards, RCRA and New Jersey hazardous waste management regulations, air pollution control requirements and other associated action-specific ARARs. The removed material would be properly packaged and manifested for transportation to an off-site RCRA permitted treatment facility. This alternative would also meet the other action-specific ARARs common to all alternatives identified in Table 4-8, as well as the associated location-specific ARARs identified in Table 4-9.

Because off-site flame reactor treatment would result in materials no longer exhibiting the RCRA hazardous characteristic of toxicity, land disposal restrictions would be satisfied. The treated material may possibly be deposited off site as clean fill or road aggregate.

Long-Term Effectiveness

The removal of contaminated slag and lead oxide materials from the site would reduce the potential human health risks associated with direct contact with slag and lead oxide materials, the inhalation of airborne particulates, and the leaching of contaminants into surface water and groundwater. Following, remediation the site would not require any long-term management and monitoring.

Reduction of Toxicity, Mobility or Volume Through Treatment

Removal of slag and lead oxide materials and treatment at off-site Flame Reactor constitutes a treatment which would

result in a permanent remedy. The heavy metal contaminants in the slag and lead oxide materials would be completely removed from the site, immobilized and possibly recycled along with metal enriched oxides, although at this time, no markets have been identified for these materials. This treatment alternative would reduce the toxicity, mobility and volume of contaminants at the site. Volume reduction is estimated to be 10 to 20 percent. In addition, further contamination of surface water and groundwater would be eliminated because the leaching of contaminants would be prevented. Airborne particulates would also be eliminated by removal of the contaminant source.

Short-Term Effectiveness

The potential public health threats to workers and area residents would include direct contact with slag and lead oxide materials and inhalation of fugitive dust generated during removal and handling. There would not be any dust evolution from treatment system, since no on-site treatment is employed. The area would be secured and access would be restricted to authorized personnel only. Dust control measures such as wind screens and water sprays would be used to minimize fugitive dust resulting from material handling. Air monitoring for particulates would be conducted throughout the site activities.

The risk to workers would be minimized by the use of adequate preventive measures, such as enclosed cabs on backhoes and proper personal protection equipment, in accordance with a site-specific Health and Safety Plan. Semi-automated packing of the slag and lead oxide materials for off-site Flame Reactor treatment would reduce workers exposure to contaminants. Erosion and sediment control measures such as berms would be provided during material handling activities to control migration of contaminated materials to surface waters via runoff from the site.

The short-term impacts on the environment would be increases in traffic and noise pollution resulting from the hauling of contaminated materials off-site. Transportation of slag and lead oxide materials may introduce short-term risks, with the possibility of spillage along the transport route. A total period of 18 months is estimated for this remedial alternative for design and testing, bidding, contractor selection, and remediation based on currently available treatment capacity of 3 tons/hour. The actual remediation period is estimated to be 6 months.

Implementability:

o Technical Feasibility

This technology is currently being tested under EPA's Superfund Innovative Technology Evaluation (SITE) Program which evaluates new and promising hazardous waste cleanup technologies.

Although this technology is used for electric arc furnace dust on full scale, it has not been used for CERCLA waste on a full-scale basis. The vendor estimates that a full-scale unit for CERCLA waste may be operational in about a year.

Furthermore, the waste would have to undergo a series of analyses prior to acceptance for treatment at the off-site facility. Sufficient land is available at the site for staging and support facilities. Removal, packing and transportation to an off-site Flame Reactor facility could be done without difficulty.

o Administrative Feasibility

Implementation of this alternative would require restriction of access to the site during the remediation process. Procurement of an off-site Flame Reactor facility to handle the type and volume of materials on site would be required along with coordination with State and local agencies. Transportation of hazardous waste would require appropriate permits and coordination with the Department of Transportation (DOT) and local traffic department. Traffic control plans would be required before remediation. Manifests would be required for hazardous waste transportation. The off-site Flame Reactor facility selected for treatment would have to be in compliance with appropriate permit conditions.

o Availability of Services and Materials

Although a commercial facility is not available currently, the vendor claims that it may be available in about a year. Only one vendor is available for this technology and therefore, competitive bids may not be available. The number of commercial facilities is likely to increase with time; however, severe limitations imposed by the current permitting process make it difficult to predict availability of new facilities. Unavailability of facility or capacity could lead to schedule delays. Removal and transportation should not pose problems.

Cost

The capital cost for this alternative is estimated at \$4,215,100. A separate operation and maintenance cost is not required since the capital cost includes all costs. The present worth is same as capital cost. Detailed supportive data used to derive these estimates are presented in Table A-2 of Appendix A and Table B-2 of Appendix B.

5.2.3 Alternative SP-4: On-Site Hydro-Metallurgical Leaching/On-Site Disposal

5.2.3.1 Description

Site preparation for this alternative would include an equipment staging area and support facilities. This alternative consists of removal of approximately 9,800 cy of slag material and 200 cy

of lead oxide material including lead-bearing debris and treating on site using a hydro-metallurgical leaching process. Treated material would be placed on site in accordance with RCRA treatment standards. For cost estimating purposes, it was assumed that on-site placement would meet RCRA Subtitle D requirements, although the actual disposal requirements would be defined in design, pending treatability studies. A long-term monitoring program would be instituted for the treated material.

On-Site Hydro-metallurgical Leaching

Slag and lead oxide materials would be moved by earth moving equipment as described in Alternative SP-3. The rate of removal of materials would be limited by the processing rate of the mobile treatment unit.

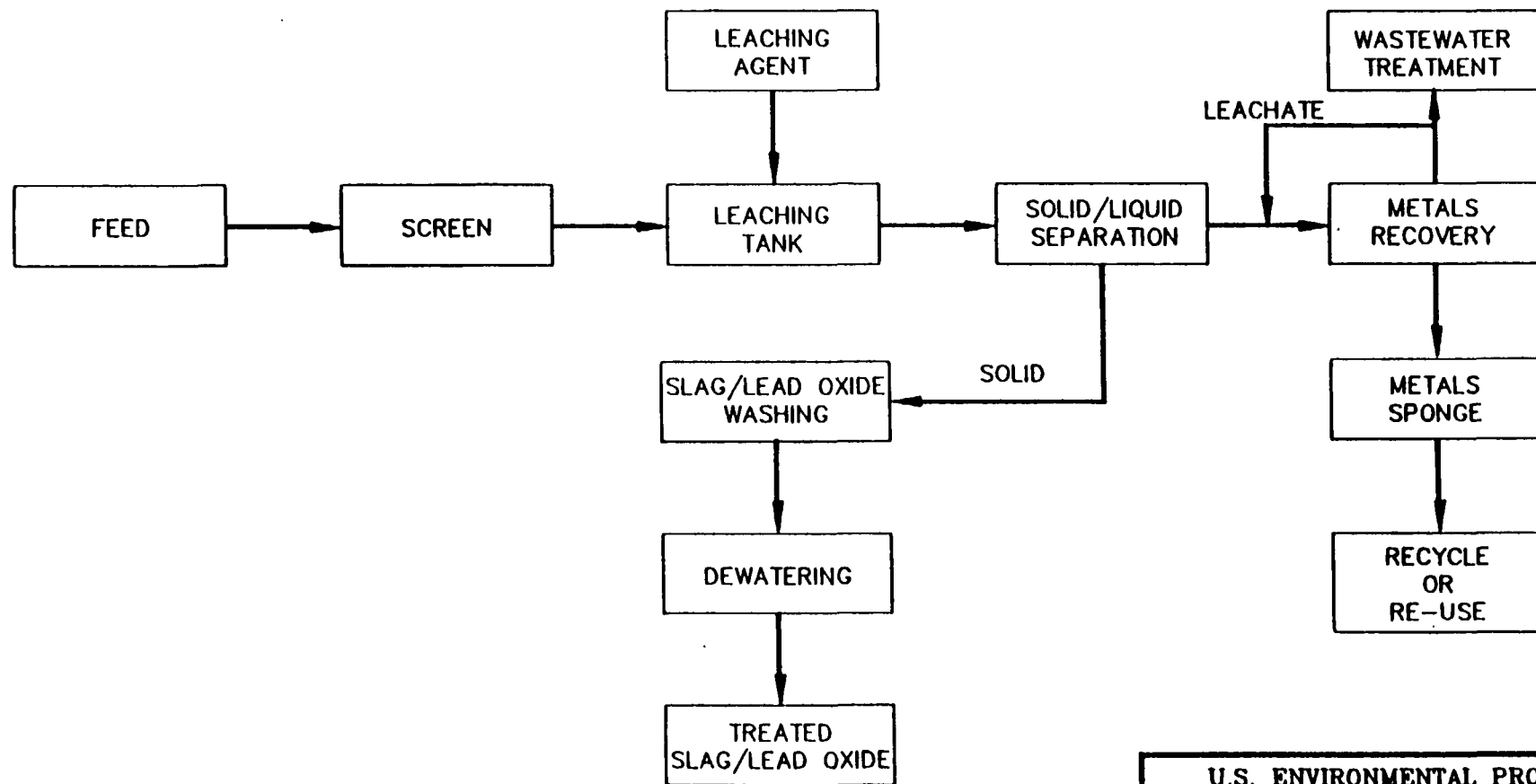
The hydro-metallurgical leaching process is based on the principles of hydro-metallurgy commonly used for the extraction of metals from ores. This technique uses a hot aqueous caustic leach solution for the extraction of heavy metals from the waste. This solution can be regenerated after recovery of the dissolved metal values for subsequent leaching, thus minimizing reagent costs, reducing the waste volume and generating a possibly marketable product from existing toxic residues. Figure 5-2 depicts a schematic flow diagram for this technology. This technology is based on the ability of caustic solutions to extract oxidic lead compounds (lead oxide) efficiently from the complex residue assemblage without attacking the significant volumes of inert material present in the waste.

The leaching step is followed by filtration, whereby the delead residue is separated and collected. The lead and halide-rich leach filtrate is then reacted with metallic aluminum fines to precipitate the lead (and other dissolved metals lower than aluminum on the electromotive series). The precipitate is a lead-rich, marketable metallic sponge product. In the process the aluminum is solubilized as sodium aluminate and a small amount of caustic is generated.

After a certain quantity of the spent solution is bled from the circuit, (to remove some of the remaining dissolved impurities), the solution is recycled. The bled solution is processed in a water treatment system for separation and removal of residue metals. The recycle liquor must also be replenished with fresh caustic in accordance with leaching requirements.

On-Site Disposal

Treated residues would be tested using the TCLP test. After passing the TCLP test, treated residue would be placed on site in accordance with RCRA treatment standards. For cost-estimating purposes, it was assumed that on-site placement would meet RCRA Subtitle D requirements, although the actual disposal requirements would be defined in design, pending



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FIGURE 5-2

ALTERNATIVE SP-4
HYDO-METALLURGIAL LEACHING PROCESS
FLOW DIAGRAM

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treatability studies. A long-term monitoring program would be instituted to monitor potential migration of residual contaminants from the treated materials.

5.2.3.2 Assessment

Overall Protection of Human Health and the Environment

This alternative may reduce the public health risks associated with direct contact and leaching of contaminants from the slag and lead oxide materials into surface water and groundwater. Treated material is expected to pass TCLP and would be considered as nonhazardous. This treatment alternative may reduce toxicity, mobility and volume of the contaminants in the slag and lead oxide materials; however, some uncertainty exists due to presence of multiple metals. Multiple leaching steps may be required to achieve treatment goal. Treatability studies would be required to determine if treatment objectives can be achieved. Treated materials would be placed on site in accordance with RCRA treatment standards. For cost-estimating purposes, it was assumed that on-site placement would meet RCRA Subtitle D requirements, although the actual disposal requirements would be defined in design, pending treatability studies. This alternative may result in overall protection of human health and the environment.

Compliance with ARARs

This alternative would meet the action- and location-specific ARARs identified in association with it. However, some questions still remain as to the effectiveness of hydro-metallurgical leaching in the presence of multiple metals in completely meeting the contaminant-specific ARARs.

This alternative would be conducted in accordance with the associated action-specific ARARs. These ARARs were discussed under Alternative SP-3. The material would be treated using hydro-metallurgical leaching, which has been an effective method for removing lead from ores. This treatment may meet the contamination-specific ARARs identified in Table 4-7 by reducing toxicity, mobility and volume of contaminated material, rendering it no longer RCRA characteristic. However, some uncertainty exists due to the presence of multiple metals and the nature of the waste.

The treated material would be placed on site in accordance with RCRA treatment standards. For cost estimating purposes, it was assumed that on-site placement would meet RCRA Subtitle D requirements. Assuming that the treated material would no longer exhibit RCRA hazardous characteristics, land disposal restrictions would not be triggered.

Any waste resulting from the hydro-metallurgical leaching process that is characterized as hazardous will be properly transported off site for treatment and disposal in accordance with the associated ARARs.

This alternative would also comply with the location-specific ARARs identified in Table 4-9.

Long-Term Effectiveness

The heavy metal contaminants, including lead and cadmium, should be removed by this alternative. Treated materials from the hydro-metallurgical leaching process would be expected to pass the TCLP test. The hydro-metallurgical leaching process system would generate a concentrated extractant which would be used to recover metals. Treatment residues would be placed on site in accordance with RCRA treatment standards. Land use restrictions would be required in this disposal area. A long-term monitoring program would be required.

Reduction of Toxicity, Mobility or Volume Through Treatment

This alternative would eliminate the source of contaminants to surface water, groundwater and air at the NL site through treatment. This process would remove contaminants, particularly lead, and reduce toxicity, mobility and volume of contaminants. There would be no significant reduction in volume of the treated material. Heavy metals, particularly lead, would be ultimately recycled during secondary waste management of spent leachate solution.

Short-Term Effectiveness

The potential public health threats to workers and area residents would include direct contact with contaminated slag and lead oxide materials and inhalation of fugitive dust generated during removal and handling activities. The area would be secured and access would be restricted to authorized personnel only. Dust control measures such as wind screens and water sprays would be used to minimize fugitive dust emissions resulting from material handling. Air monitoring for particulates would be conducted throughout the site activities.

The risk to workers would be minimized by the use of adequate preventive measures, such as enclosed cabs on backhoes and proper personal protection equipment, to prevent direct contact with contaminated materials and inhalation of fugitive dust. The hydro-metallurgical leaching system is a closed-loop, totally enclosed unit. The facilities would be designed in compliance with the applicable OSHA industrial requirements to minimize the probability of leakage, spills and explosions. All site activities would be conducted with strict adherence to the site-specific Health and Safety Plan. The final leachate volume from treatment would be a very small, compared to the contaminated slag and lead oxide volume, but would be highly concentrated in nature. Metals would be recovered from this solution.

Erosion control measures such as berms would be provided during removal activities to control migration of slag and lead oxide materials to surface waters via runoff from the site. Some increase in traffic and noise pollution would be expected from site activities. A total remediation period of approximately 16 months, including design and testing, bidding, contractor selection, on-site hydro-metallurgical leaching and site restoration is estimated for this alternative based on available treatment capacity of 100 cy per day. The actual remediation period is estimated to be 4 months.

Implementability

o Technical Feasibility

The hydro-metallurgical leaching process has been developed and proven by the metallurgical industry for extraction of metals from ores. A bench- or pilot-scale treatability study would be needed to develop the design criteria. There is some uncertainty that the treated slag and lead oxide materials would meet target levels. Adequate space is available for disposal of treated residues on site.

Sufficient land is available at the NL site for operation of a mobile hydro-metallurgical leaching system plus supporting facilities. The construction, operation and maintenance of the equipment for this alternative would not be expected to cause problems, if the system is properly designed based on bench- and/or pilot-scale testing results.

Test runs would be required to determine actual performance on the slag and lead oxide materials, and also to generate treated samples for the TCLP. Treated material would be placed on site in accordance with RCRA treatment standards. For cost-estimating purposes, it was assumed that on-site placement would meet RCRA Subtitle D requirements although the actual disposal requirements would be defined in design, pending treatability studies.

o Administrative Feasibility

Implementation of this alternative would require restriction of access to the site during the remediation process. Coordination with State and local agencies would be required during remediation. A long-term monitoring program would be required to monitor the migration of residual contaminants, if any, from the landfill. Although no permits would be required for on-site remediation, substantive requirements for the permits would have to be satisfied. Most implementation activities would be performed within the site area.

No significant assistance from the local authorities would be required for traffic control because treatment is done on site and any transportation would involve nonhazardous material.

o Availability of Services and Materials

The hydro-metallurgical leaching process is commercially available and proven by the metallurgical industry. A number of vendors are available and competitive bids are expected. Earth moving equipment is available from a number of vendors for lease or purchase. Long-term monitoring would be required for the landfill. Monitoring technologies are readily available.

Cost

The capital cost for this alternative is estimated at \$2,980,400. Annual operation and maintenance cost for this alternative is estimated at \$17,000. In addition, it is estimated that \$10,000 would be required for each five-year review. Total present worth is estimated at \$3,269,500. Detailed supportive data used to derive these estimates are presented in Table A-3 of Appendix A and Tables B-3 and B-11 of Appendix B.

5.2.4 Alternative SP-5: On-Site Stabilization
(Solidification)/On-Site Disposal

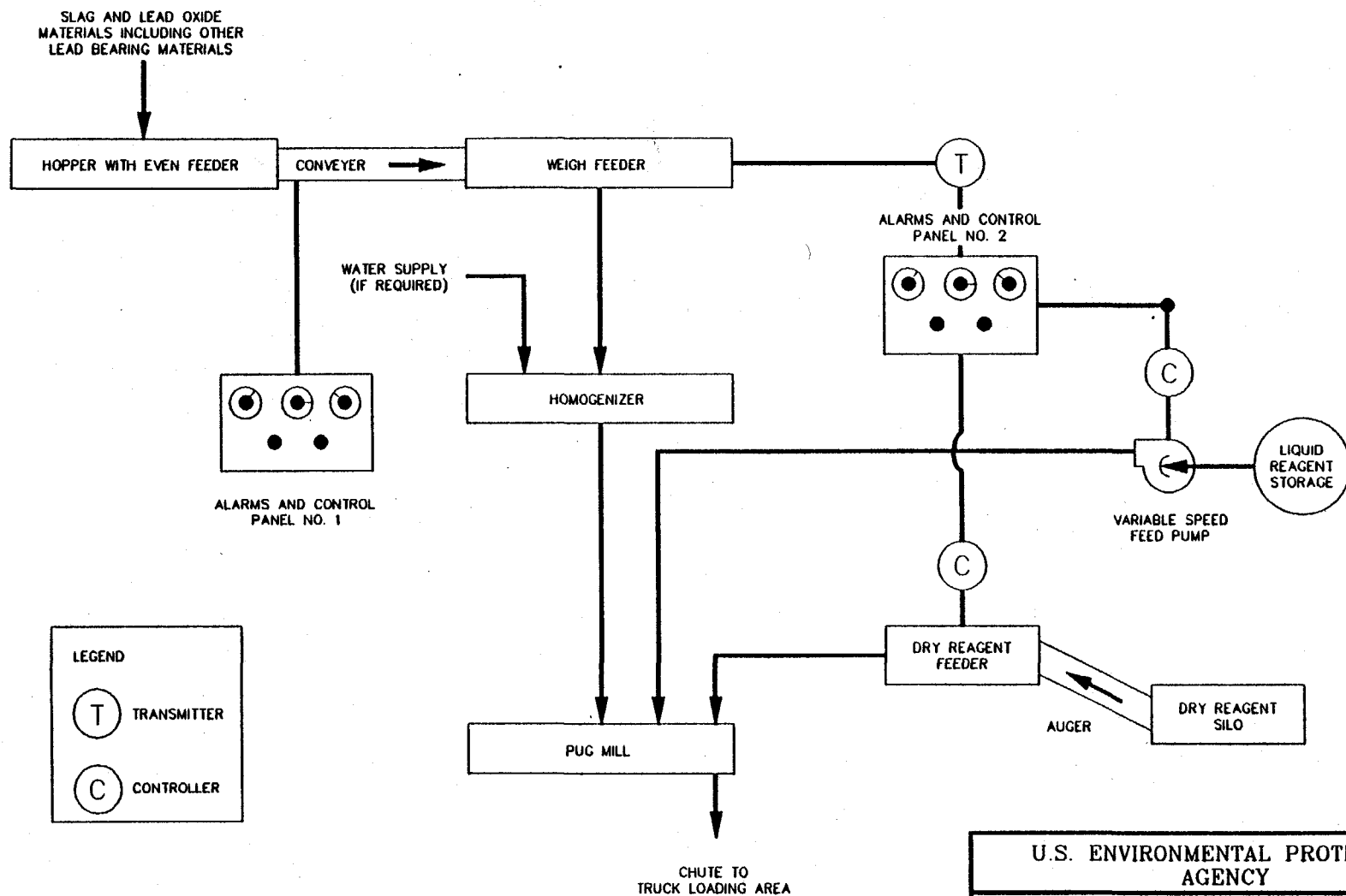
5.2.4.1 Description

Site preparation for this remedial alternative would include an equipment staging area. Support facilities would also be installed. The major features of this alternative include slag and lead oxide handling, on-site stabilization using mobile treatment system. Stabilized material would be placed on site in accordance with RCRA treatment standards. For cost estimation purposes, it was assumed that on-site placement would meet RCRA Subtitle D requirements, although the actual disposal requirements would be defined in design, pending treatability studies. A schematic diagram of the stabilization system is shown in Figure 5-3.

On-Site Stabilization (Solidification)

Approximately 9,800 cy of slag material from four separate piles and 200 cy of lead oxide material including lead bearing debris would be moved using earth moving equipment similar to Alternative SP-4 and stabilized on site.

The material would be loaded into a batch plant and weighed. Appropriate dry reagents such as portland cement, fly ash, silicate and/or proprietary reagents would be added. The mixture would be conveyed to a concrete mixing truck, pug mill or other high shear mixing equipment, where water would be added



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FIGURE 5-3
ALTERNATIVE SP-5
STABILIZATION/SOLIDIFICATION
PROCESS FLOW SCHEMATIC DIAGRAM

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and the mixture would be thoroughly blended. Standing water on site may be used as source of water for this process. The treated material volume may increase up to 40 percent with the addition of hydration water and dry reagents, depending on the reagents added. All the contaminants of concern would be bound within the matrix. The chemically stabilized material would be transferred to a temporary area for curing. A berm would be constructed at the perimeter of the curing area to prevent erosion.

On-site Disposal

Stabilized material would be tested using the TCLP test and disposed of on site. A long-term monitoring program would be instituted to monitor the possible migration of contaminants from stabilized materials.

5.2.4.2 Assessment

Overall Protection of Human Health and the Environment

Slag and lead oxide material removal, and stabilization/solidification of contaminants would reduce the public health risks associated with direct contact and leaching of contaminants from slag and lead oxide piles into surface water and groundwater. Treated material is expected to pass TCLP and would be considered as nonhazardous. Slag and lead oxide materials contaminated with inorganic contaminants would be stabilized/solidified and placed in protective manner. Toxicity of inorganic contaminants may remain unaltered. However mobility would be substantially reduced. Volume of stabilized material may increase up to 40 percent due to stabilization chemical additives. Stabilization/solidification would reduce the risks to the environment associated with the migration of contaminants off site. This alternative would result in overall protection of human health and the environment.

Compliance With ARARs

This alternative would meet all of the associated ARARs identified. It would meet the contaminant-specific ARARs identified in Table 4-7 by removing and treating the contaminated material. The removal and solidification of the contaminated material (thereby reducing the mobility of the contaminants), would leave behind material no longer exhibiting RCRA hazardous waste characteristics. The removal activities would be conducted in accordance with the associated action-specific ARARs as discussed in Alternative SP-3.

The treated material would be placed on site in accordance with RCRA treatment standards. Because the material would no longer be RCRA characteristic hazardous waste, land disposal restrictions would be satisfied. This alternative would comply with the location-specific ARARs identified in Table 4-9.

Long-Term Effectiveness

This alternative would eliminate the source of surface water, groundwater and air contamination. Contaminated slag and lead oxide materials would be converted into a stable matrix with minimal free water. Potential for leaching metals would be minimal; however, long-term reliability is not well known. Stabilized/solidified material would be placed on site in accordance with RCRA treatment standards. Land use restrictions would be required in this disposal area. A long-term monitoring program would be required to monitor the possible migration of contaminants from stabilized materials.

Reduction of Toxicity, Mobility or Volume Through Treatment

Stabilization/solidification would not reduce the toxicity or volume of inorganic contaminants. In fact, the volume of stabilized material would increase by most of the stabilization processes due to additives, although one process claims to reduce volume. Stabilization will immobilize inorganic contaminants.

Short-Term Effectiveness

The potential public health threats to area residents and workers would include direct contact with contaminated slag and lead oxide materials and inhalation of fugitive dust generated during materials handling and stabilization/solidification. The potential sources of fugitive dust emissions during stabilization would be limited to cement and fly ash. The storage and handling of these materials would be performed in a closed silo or within a vessel equipped with proper dust control devices. The area would be secured and access would be restricted to authorized personnel only. Dust control measures such as wind screens and water sprays would be used to minimize fugitive dust emission from material handling. Air monitoring for particulates would be conducted throughout the site activities.

The risk to workers would be minimized by the use of adequate preventive measures, such as enclosed cabs on backhoes and proper personal protection equipment, to prevent direct contact with contaminated materials and inhalation of fugitive dust. Operators would be well trained to observe OSHA regulations. All site activities would be in accordance with site-specific Health and Safety Plan.

Erosion control measures such as berms would be provided during material handling activities to control migration of contaminated materials to surface waters via runoff from the site. Some increase in traffic and noise pollution would be expected from site activities. A total remediation period of approximately 15 months, including design and testing, bidding, contractor selection, stabilization/solidification and disposal is estimated for this alternative based on available treatment capacity of 200 cy per day. The actual remediation time is estimated to be 3 months.

Implementability:

o Technical Feasibility

All the components of this alternative are well developed and commercially available for implementation at the site. Stabilization/solidification of inorganic contaminants have been demonstrated and proven.

Sufficient land is available at the site for operation of a mobile stabilization/solidification system plus supporting facilities and construction of a landfill for disposal of stabilized materials. Bench-scale tests would be required for stabilization/solidification to arrive at optimum formulation of stabilizing agents.

Chemical stabilization/solidification for inorganic contaminants is a proven technology. The treatment components associated with this technology, i.e. material handling, blending and mixing, are reliable. This process utilizes conventional cement mixing and blending equipment that can handle many variations in material composition and additive constituents. Stabilized/solidified materials would be placed on site as nonhazardous waste in accordance with RCRA treatment standards. For cost estimation purposes it was assumed that on-site placement would meet RCRA Subtitle D requirements although the actual disposal requirements would be defined in design, pending treatability studies. Technologies associated with long-term monitoring required for the on-site disposal are readily available and proven.

o Administrative Feasibility

Implementation of this alternative requires restriction of access to the site during the remediation process. Land use restrictions would be required for stabilized/solidified material disposal area. Coordination with State and local agencies would be required during remediation. Although no permits would be required for on-site remediation, substantive requirements for permits would have to be satisfied.

o Availability of Services and Materials

Stabilization/solidification services are available from many vendors. Earth moving equipment such as backhoes and front-end loaders are provided by numerous vendors and would be readily

available for lease or purchase. Sufficient land is available on site for disposal of stabilized/solidified material.

Cost

The capital cost for this alternative is estimated at \$2,014,000. Annual operation and maintenance cost for the on-site disposal option is estimated at \$17,000. In addition, it is estimated that \$10,000 would be required for each five-year review. Total present worth is estimated at \$2,303,100. Data in support of these cost estimates are presented in Table A-4 of Appendix A and Tables B-4 and B-12 of Appendix B.

5.3 ALTERNATIVE ANALYSIS FOR DEBRIS AND CONTAMINATED SURFACES (BUILDINGS AND EQUIPMENT) (CS)

The remedial alternatives for debris and contaminated surfaces that passed the initial screening process in Section 4.0 will be evaluated further in detail against the seven evaluation criteria as follows:

- o Alternative CS-1: No Action
- o Alternative CS-2: Contaminated Surfaces Decontamination/
Off-site Treatment and Disposal

5.3.1 Alternative CS-1: No Action

5.3.1.1 Description

The No Action alternative for the debris and contaminated surfaces includes institutional management of a long-term maintenance and control program. Institutional control will restrict the use of the buildings and equipment. Currently the building doors are locked. Building roofs would be repaired to prevent leakage. No additional security measures would be needed. A long-term inspection and maintenance program would be implemented to ensure security of the buildings. A public awareness program consisting of press releases, circulars and public meetings would be instituted to educate local residents about potential hazards related to debris and contaminated surfaces. Five-year reviews would be performed to assess the need for future actions.

5.3.1.2 Assessment

Overall Protection of Human Health and the Environment

This remedial alternative slightly reduces the risks of human contact. However, significant risks remain because all contaminants remain on the site and in the buildings. Roof repair would prevent transport of contaminants through rain water. The locked doors of the buildings limit building access;

however, further exposures to the contaminants are possible, if access restrictions are violated by trespassers. Environmental risk to birds would not be changed by this alternative because they would be exposed to dust. This alternative would provide protection to human health and the environment as long as the building is locked and its use is prohibited.

Compliance With ARARs

This alternative fails to limit the source of contamination. Since the contamination will remain on site, contaminant-specific ARARs will not be met. Action-specific ARARs concerning site security will be met. The location-specific ARARs identified in Table 4-9 will not be impacted by this alternative.

Long-Term Effectiveness

Locked doors would restrict access to the buildings, and therefore somewhat reduce the risk of human contact with contaminants in the buildings. However debris is staged outdoors and is susceptible to vandalism; therefore, the potential for direct contact, ingestion and inhalation by trespassers exists. Roof repair would prevent leakage and thereby eliminate the potential for contaminant transport through rain water. This would also prevent eventual degradation of buildings.

The doors may have to be maintained and replaced since they could be knocked down, lost, stolen, or damaged. The long-term maintenance program designed to maintain the security of the building should be effective in minimizing trespassing.

Reduction of Toxicity, Mobility or Volume

There is no reduction of the toxicity and volume of debris and contaminated dust in the buildings because they are left in place at the site. However the repaired roofs would reduce potential of mobility of contaminants in the buildings through leaked water.

Short-Term Effectiveness

This alternative would reduce the potential for direct contact with the debris on the site and contaminants in the buildings. Currently the buildings are locked. Roof repair would limit exposure of the community to some contaminants; however, workers would be exposed to a greater degree. This would be mitigated by protective clothing. Applicable OSHA regulations would be observed to prevent workers from normal construction hazards.

It is estimated that less than one month would be required for roof repairs.

Implementability

o Technical Implementability

Roof repair is a common construction procedure and easily implemented. The long-term maintenance program to secure the buildings is easy to implement. If the buildings are to be reused in the future, additional remedial actions such as decontamination and removal of debris may be needed.

o Administrative Feasibility

Roof repair would not require permits. Compliance with OSHA regulations would be required. Considerable long-term institutional management would be required for institutional controls, public education programs and five-year reviews. Building maintenance would also be required.

o Availability of Services and Materials

Roof repair and building maintenance are common construction procedures and a number of roofing contractors are locally available. The required materials and labor are readily available. Routine inspections can be easily undertaken and labor is available.

Cost

The capital cost for this alternative is estimated to be \$17,700. The annual operating and maintenance costs will be approximately \$6,800. In addition, approximately \$5,000 would be required for each five-year review. The total present worth, calculated on the basis of a discount rate of 5 percent and 30-year period, is \$136,100. Data in support of these cost estimates are presented in Table A-5 of Appendix A and Tables B-5 and B-13 of Appendix B.

5.3.2 Alternative CS-2: Contaminated Surface Decontamination/ Off-Site Treatment and Disposal

5.3.2.1 Description

This alternative includes decontamination of the debris, buildings, paved areas and equipment to remove contaminated dust, and off-site treatment and/or disposal of dust and decontaminated debris. Any recyclable debris would be recycled. Debris that could not be decontaminated, such as contaminated baghouse bags, would be transported to an appropriate off-site RCRA hazardous waste treatment and disposal facility.

Hazardous dust contaminated with metals would be removed using a dusting, vacuuming and wiping procedure and then sent off site for treatment and disposal at a RCRA-permitted treatment and disposal facility. The parts of the buildings and equipment which can withstand high water pressure would be cleaned by hydroblasting. The contaminated water resulting from the decontamination procedures would be treated and/or disposed of in the same manner as the standing water.

5.3.2.2 Assessment

Overall Protection of Human Health and The Environment

This alternative would adequately protect public health and the environment due to the removal of the contaminated dust and debris from the site. After building decontamination, the buildings should be fit to enter safely without public health risks resulting from contaminants.

Compliance With ARARs

This alternative would meet all the associated contaminant-, action- and location-specific ARARs identified. Dusting, vacuuming and wiping are effective methods of surface decontamination and would achieve the associated contaminant-specific ARARs identified in Table 4-7. The decontamination, packaging and manifesting of contaminated material resulting from decontamination for off-site treatment and disposal would be in accordance with the associated action-specific ARARs identified in Table 4-8. This alternative would also comply with the location-specific ARARs identified in Table 4-9. Some surface contamination involves RCRA-listed waste, particularly listed waste K069, lead dust. Therefore, materials resulting from decontamination would be treated in accordance with RCRA Land Disposal Restrictions and disposed of at a Subtitle C landfill using BDAT, or a treatability variance would be obtained.

Long-Term Effectiveness

Dusting, vacuuming, wiping and hydroblasting are effective decontamination techniques to remove contaminated dust from the buildings and surfaces. Effectiveness of decontamination would be monitored by taking post-remediation wipe samples. After decontamination, there would not be any chemical risk that would prevent the safe entry into the building.

Trucks would be used to transport contaminated debris and dust to an off-site RCRA disposal facility. Decontaminated debris may be disposed of at an off-site subtitle D landfill. Any recyclable debris would be recycled. Thus, the building would be completely decontaminated and could be entered without human health risks.

Reduction of Toxicity, Mobility or Volume

All of the contaminated dust (approximately 70 cubic yards, based on a 40,000 sy area and 1/16" thickness) would be completely removed from the buildings and sent to an off-site treatment/disposal facility. Decontaminated debris (estimated to be 2,500 cy) would be disposed in an off-site Subtitle D landfill. Therefore, complete reduction of the toxicity, mobility and volume of the contaminated dust and debris would be achieved.

Short-Term Effectiveness

This remedial alternative poses minimal potential risks to the community in the form of increased dust during building, equipment and debris decontamination procedures. There is a potential for short-term risks resulting from potential accidents during the transport and disposal of the contaminated dust and debris. Safeguards would be implemented to minimize these risks, which are not considered significant. A small risk to site workers is probable. However, a site-specific Health and Safety Plan would be implemented to protect workers from dermal contact, ingestion, and inhalation of dust during implementation. Some parts of the buildings, such as stairs and walkways, are weak and would require structural assessment before use and decontamination. The kiln burner, feed, and decasing buildings have asbestos panels for walls and roofs. These would not be hydroblasted. These areas would be decontaminated by vacuuming, dusting or wiping. A total period of one year is estimated for this remedial alternative for design, testing, bidding, selecting a contractor and decontamination. The actual decontamination period is estimated to be three months.

Implementability

o Technical Implementability

Dusting, vacuuming, wiping and hydroblasting technologies are easily implemented. For the large surface areas in the buildings, such as walls and floors, vacuuming can be performed using a commercial or industrial vacuum equipped with a high-efficiency particulate air filter. For other areas, such as the pipes and ledges, which are not treatable using a vacuum, wiping can be performed using a damp cloth. Areas of the buildings and equipment which can withstand high pressure would be decontaminated using hydroblasting.

After the first cleaning, wipe samples would be taken to determine the removal effectiveness. If the cleanup levels (nondetectable) have not been achieved, the same procedures would be repeated as needed. Based on the extent of contamination inside the buildings, one thorough cleanup should remove all of the contaminated dust. The used filters and damp cloths containing contaminated dust would be disposed of as hazardous wastes.

Trucking of wastes to disposal facilities has been used at other Superfund sites and it is assumed to be in accordance with applicable regulations at this site.

o Administrative Feasibility

On-site decontamination would not require any permits, but substantive requirements must be met. Transportation of contaminated dust would require DOT permits. Manifestation would be required for transportation of hazardous waste.

o Availability of Services and Materials

Dusting, vacuuming, wiping and hydroblasting technologies are readily available through several sources, and competitive bids would be available. A number of off-site facilities are available for disposal of dust and decontaminated debris.

Costs

The capital cost for this alternative is estimated to be \$1,691,100. There would be no maintenance cost. Data in support of this cost estimate is presented in Table A-6 of Appendix A and Table B-6 of Appendix B.

5.4 ALTERNATIVE ANALYSIS FOR STANDING WATER AND SEDIMENTS (SW)

The standing water and sediment remedial alternatives that passed the initial screening process in Section 4.0 and will be evaluated further in detail against the seven evaluation criteria are as follows:

- o Alternative SW-1: No Action
- o Alternative SW-2: On-Site Treatment and Groundwater Recharge
- o Alternative SW-3: Off-Site Treatment and Disposal

5.4.1 Alternative SW-1: No Action

5.4.1.1 Description

The No Action alternative for the contaminated standing water ponded throughout the NL site would include only a long-term monitoring program. The contaminated water and sediments underlying the standing water would be left to natural attenuation without any treatment and/or disposal. Drains would remain plugged and contaminated. The long-term monitoring program would consist of annual sampling of standing water and groundwater for TCL metals and would utilize existing wells to track the migration of contaminants of concern in the aquifers.

Selected monitoring wells surrounding the manufacturing area (See Figure 5-4) would be utilized to sample the groundwater in order to monitor potential migration of contaminants downgradient of the site. Exact wells to be sampled would be determined when the monitoring program begins. In addition, surface water samples would be taken from the West Stream and the East Stream to monitor potential migration of contaminants in the stream.

The site would be inspected during all sampling episodes to provide adequate maintenance/repair to the monitoring wells. A public education program consisting of distribution of circulars, press releases, and public meetings would be provided to increase public awareness. Institutional management would also be required to review the site every five years as required by CERLCA as amended. A 30-year monitoring period is used for cost-estimation purposes.

5.4.1.2 Assessment

Overall Protection of Human Health and the Environment

The No Action alternative would not entail removal of contaminated standing water and sediments or its treatment and/or disposal. It is estimated that it could take well in excess of 30 years for natural attenuation to reduce the contaminant concentrations to the ARAR-based cleanup levels. However, a 30-year period was used for costing purposes. This alternative would not actively reduce the toxicity, mobility or volume of hazardous contaminants in the standing water and sediments. The ability of this alternative to prevent exposure would directly depend on the effectiveness of the public awareness program in minimizing the on-site exposure to contaminated standing water and sediments. The volume of contaminated standing water may fluctuate and potential off-site release to the environment and public exposure would continue. This alternative is not expected to meet Federal and State ARARs in the near future. Adverse impact on the downgradient and off-site groundwater quality would continue due to migration of contaminants from the site. This alternative is not considered responsive to the remedial objectives, but, rather, provides a "base case" for comparison with other alternatives.

Compliance with ARARs

The No Action alternative for standing water and sediments involves implementing a monitoring program to observe the distribution and migration of contaminants. The No Action alternative would leave contaminated standing water and sediments at the site. Alternative SW-1 would not satisfy contaminant-specific ARARs.

Long-term standing water monitoring would comply with pertinent RCRA action-specific ARARS identified in Table 4-8. This alternative would not comply with location-specific ARARS identified in Table 4-9.

Long-Term Effectiveness

Long-term risks associated with the No Action alternative are related to migration of contaminants through surface water and groundwater. The potential human health risks would still exist through the potential exposure pathways, primarily direct contact and ingestion.

A long-term monitoring program would be required to monitor contaminant migration. As required by CERCLA as amended, review and evaluation of site conditions would be performed every five years. If justified by the review, remedial actions could be required to remove and treat and/or dispose contaminated standing water and sediments. This alternative is not considered to be effective over the long term because contaminated standing water and sediments would remain on site and further contaminate surface water and groundwater.

Reduction of Toxicity, Mobility or Volume Through Treatment

This alternative would not involve any removal, treatment or disposal of the contaminated standing water and sediments; therefore, no effective reduction in toxicity, mobility or volume would result. However, the volume of contaminated standing water may fluctuate.

Short-Term Effectiveness

The No Action alternative for standing water involves implementing a monitoring program to observe the distribution and migration of contaminants. There are potential short-term threats to the public health, since this alternative does not remove contaminated surface water and sediments. There is the possibility of further contamination of surface water and groundwater. There are no major short-term threats to the neighboring community or to workers during actions associated with monitoring involved in this alternative since no major construction would be involved. The workers performing sampling activities would be provided with personnel protection equipment to minimize direct contact risks and would be trained in health and safety measures. This alternative relies on natural attenuation for achievement of cleanup levels. Although this alternative would require in excess of 30 years to achieve remedial objectives, a 30-year period was used for costing purposes.

Implementability

o Technical Implementability

The No Action alternative could be easily implemented, since it does not involve any major construction. To monitor the aquifers, the existing monitoring wells would be utilized as the long-term monitoring network. These wells would be sufficient to monitor the migration of contaminants in the aquifers. Surface water contamination would be monitored by taking samples from the West Stream and the East Stream. The remaining activities would involve the collection of the samples, analysis for contaminants of concern and evaluation of the extent of contamination, which are all proven and reliable activities.

o Administrative Feasibility

Considerable effort would have to be devoted to public information meetings, workshops and presentations to increase public awareness of potential hazards related to contaminated standing water and sediments. Site reviews would occur every five years. The effectiveness and reliability of the public awareness programs are uncertain since public participation is not warranted. Coordination with State and local authorities would be required in the future for reviewing the data and making appropriate decisions. This alternative would not involve any discharge permits or off-site disposal.

o Availability of Services and Materials

This alternative would not involve any treatment, storage or disposal. Equipment and specialists for sampling, monitoring, and analytical work are available locally and several vendors are available for competitive bids.

Cost

This alternative would not require any construction, and therefore would not incur any capital cost. Annual operation and maintenance costs for this alternative is estimated to be \$10,700. In addition, approximately \$20,000 would be required for each five-year review and public awareness program. The present worth, based on a 30-year period and a discount rate of 5 percent, is \$220,100. Data in support of these cost estimates are presented in Table A-7 of Appendix A and Tables B-7 and B-14 of Appendix B.

5.4.2 Alternative SW-2: On-Site Treatment and Groundwater Recharge

5.4.2.1 Description

The major features of this alternative are standing water collection, treatment and disposal of the treated water, and a performance monitoring program. The treatment system would

consist of metals removal by chemical precipitation, flocculation, clarification and filtration. Other treatment technologies such as ion exchange or ion replacement may be used independently or in conjunction with precipitation technology. For costing purposes, precipitation technology is assumed. The treated standing water would be recharged to groundwater through injection wells or infiltration basins. The exact recharge location would be determined during the design phase. Treatment would be by a mobile treatment system. The system would treat contaminated water at a rate of 20 gpm. Sediments would be removed and treated and/or disposed of with sludge generated during water treatment. After removal of standing water and sediments, all the drainage would be unclogged to permit natural drainage, and decontaminated.

Collection

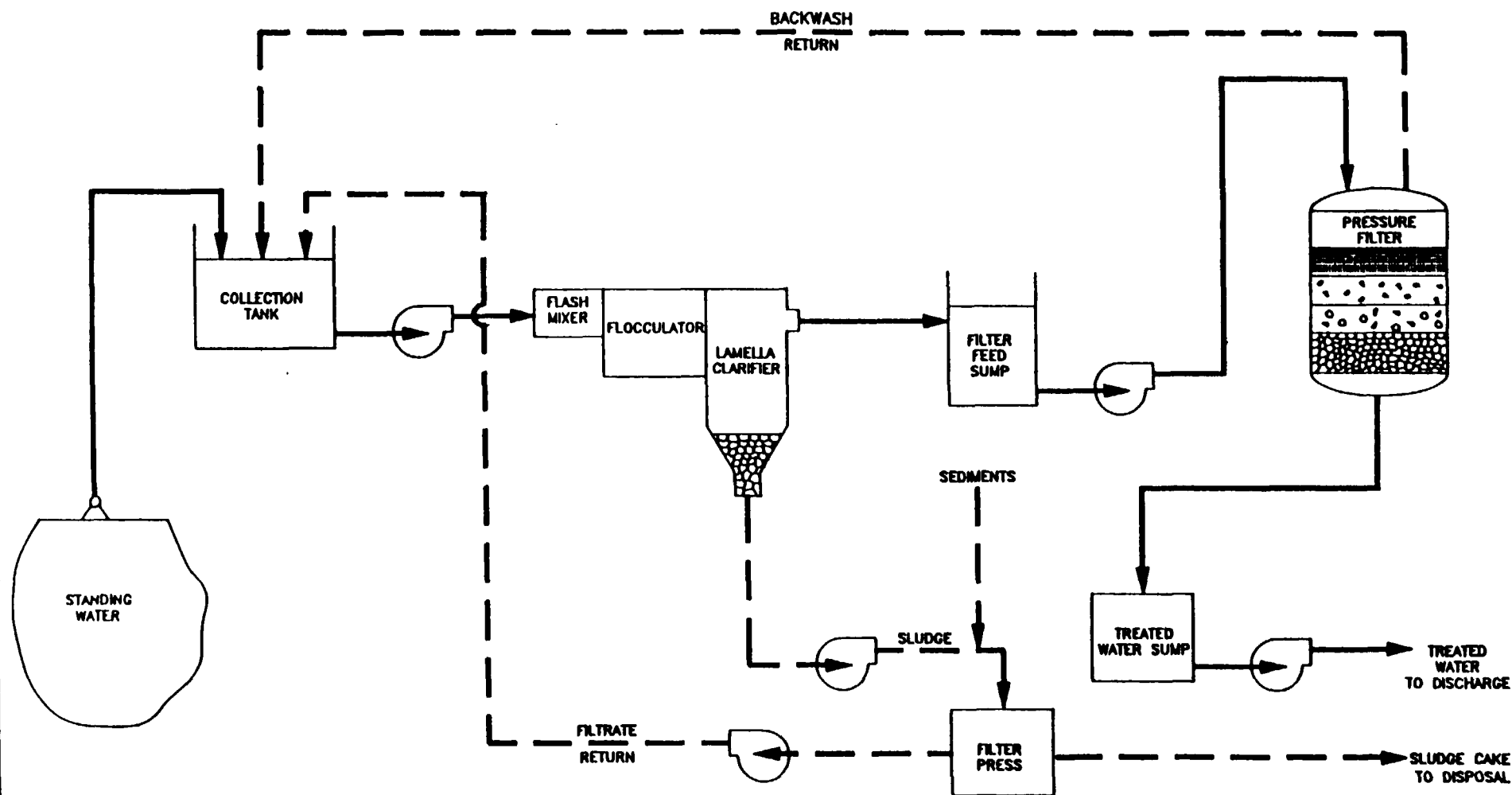
The collection system would consist of submersible pumps installed in the standing water ponded throughout the site and basement of the refining building. Approximately one million gallons of standing water would be pumped at a rate of 20 gpm to the on-site mobile treatment plant. Pumped standing water would be delivered to a collection tank before treatment. Approximately 200 cy of sediments collected at the bottom of the standing water would be pumped and dewatered on-site.

Precipitation/Clarification/Filtration

The metals removal system would consist of a treatment train designed for the removal of metals. The contaminants would be removed through precipitation, coagulation, clarification and filtration, with the addition of sodium sulfide, alum and polymer (Figure 5-5). Water from the collection tank would be pumped to a rapid mix tank.

In the rapid mix tank, chemical pumps would feed caustic to maintain a pH of 8.5, and sodium sulfide to precipitate metals as sulfide salts. The effluent would overflow by gravity into the flocculator, where polymer flocculant and a coagulant (alum) would be added to promote floc formation and to increase the settling rate of the precipitated and suspended solids originally present in the standing water. The overflow from this stage would then enter a Lamella type clarifier.

The settled sludge in the Lamella clarifier along with sediments would be periodically discharged by pumping to a filter press system for dewatering to produce a sludge cake 20-30 percent solids by weight. It would be stored in drums or rollofs, then removed to the disposal contractor's facility for treatment and ultimate disposal in a Subtitle D landfill. The extracted water from the sludge and sediments would be recirculated to the collection tank.



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FIGURE 5-5
ALTERNATE SW-2
PROCESS FLOW DIAGRAM

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To remove any remaining precipitated solids in the colloidal form that could not be removed by clarification, a filtration system would be provided. The effluent from clarifier would pass through a dual-media pressure filter equipped with backwash pumps and automatic controls. The filter backwash would be returned to the collection tank for further treatment.

On-Site Disposal

The treated water from the metals removal system would be pumped into a discharge tank. Water from this tank would be pumped to either injection wells or infiltration basins constructed on site. Exact discharge location would be determined during the design phase. Sludge generated during water treatment and sediments would be dewatered and treated and/or disposed of off-site.

5.4.2.2 Assessment

Overall Protection of Human Health and the Environment

This alternative would remove the contaminated standing water and sediments from the site and ultimately eliminate migration of contaminants into surface water and groundwater. The treatment system provided would reduce the contaminants of concern in the treated water to meet State and Federal discharge standard levels so that the treated standing water could be recharged into groundwater. This alternative would unplug the clogged drains thus preventing ponding of water on the site in the future. Drains would be decontaminated after removal of water. This alternative would result in protection of human health and the environment.

Compliance with ARARs

Alternative SW-2 would meet all associated contaminant-, action- and location-specific ARARs identified. This alternative would achieve contaminant-specific ARARs identified in Table 4-7 through the use of precipitation, clarification and filtration, and ion exchange if necessary which are effective methods for removing metals from water. The collection and treatment of contaminated water would be in accordance with other action-specific ARARs common to all alternatives identified in Table 4-9. Treated water would be recharged after meeting groundwater MCLs. Any contaminated material resulting from standing water treatment will be properly packaged and transported for off-site treatment and disposal. This alternative will also comply with location-specific ARARs identified in Table 4-9.

Long-Term Effectiveness

The major benefits associated with this alternative include elimination of contaminant migration off site and the removal of the contaminated standing water and sediments from the site.

The standing water would be treated to groundwater discharge levels prior to disposal. Drainage of the site would be restored by decontaminating and unplugging the clogged drains.

Reduction of Toxicity, Mobility or Volume Through Treatment

This alternative would offer a significant overall reduction of toxicity, mobility and volume of the contaminants of concern by collecting and treating the contaminated standing water and sediments from the ponded areas. The treatment plant would be designed to reduce contaminant concentrations to discharge levels. Sludge generated during water treatment would be disposed of along with sediments in a Subtitle D landfill after treatment for control of its potential leachability.

Short-Term Effectiveness

Potential short-term risk during implementation of this remedial alternative would be from direct contact with contaminated standing water. The significant risk to operators would be from improper handling of reagent chemicals at the site, notably sodium sulfide and caustic solutions. Proper operating procedures would be followed, precautions would be taken during the handling of any reagents, and precautions would be taken against normal construction hazards. Exposure risks such as these would be mitigated through proper health and safety training and appropriate process controls such as automatic alarms and fail safe shutdowns in case of leaks or over pressurization. The treatment plant area would be fenced and access restricted to authorized personnel; therefore exposure to the general public would be minimal. Minimal risk to the community from increased traffic during construction and transportation of treatment residuals is expected.

No major environmental impacts would be expected from this alternative. Total time for implementing this alternative, including design, testing, bidding, contractor selection and installation of the treatment plant is estimated to be 14 months. The length of time for the actual remedial action to be completed is estimated to be 3 months.

Implementability

o Technical Implementability

The primary process steps for this alternative, including pumping, chemical precipitation, clarification, filtration, and on-site recharge have been used extensively to treat and dispose of water contaminated with metals. All components of this alternative are well developed, commercially available, and are not expected to incur major technical problems that would lead to schedule delays. The treatment processes for this remedial

alternative are conventional wastewater treatment processes. Mobile units are available for on-site treatment. Proper operation and routine maintenance of the treatment plant would be required to achieve treatment goals. During the operation of the treatment system, effectiveness would be monitored by periodic analysis of contaminants in the treated water before recharge. Monitoring methods are also available and have been effectively used.

o Administrative Feasibility

This alternative would require extensive institutional management to ensure proper operation, maintenance and overall execution. Additionally, this alternative would require compliance with EPA, U.S. Department of Transportation and State regulations regarding the transport and disposal of process residuals. Although no permits are required for on-site treatment and disposal, substantive requirements must be met. Transportation of process residuals such as sludge and sediments would require manifestation.

o Availability of Services and Materials

The treatment system for this alternative consists of conventional wastewater treatment processes and can be fabricated from off-the-shelf equipment. Several suppliers are accessible for every type of equipment or technology required for this alternative. Competitive bids can be obtained from more than one vendor. Similarly, specialists are available for the design, construction and operation of this alternative as required. Process residuals generated from this alternative could be disposed of at an approved off-site disposal facility.

Cost

Capital cost for this alternative is estimated to be \$1,335,000 which also includes operation and maintenance cost. The present worth is same as capital cost. Data in support of this cost estimate is presented in Table A-8 of Appendix A and Table B-8 of Appendix B.

5.4.3 Alternative SW-3: Off-Site Treatment and Disposal

5.4.3.1 Description

This alternative entails pumping and collecting contaminated standing water and sediments into tanker trucks or rail cars and transportation to a RCRA-permitted treatment, storage and disposal facility. Drains would be decontaminated and unplugged following water and sediment removal to permit natural drainage.

The collection system for this alternative would be the same as that outlined in Alternative SW-2. However in this alternative, water and sediments would be pumped into tanker trucks or rail cars.

Collected standing water and sediments would be transported to RCRA permitted treatment, storage and disposal facility with capability to treat metal contaminated aqueous waste and sediments.

5.4.3.2 Assessment

Overall Protection of Human Health and the Environment

The removal of contaminated standing water and sediments from the site would significantly reduce the potential human health risks associated with direct contact and ingestion of contaminated water, and prevent further migration of contaminants into surface water and groundwater. This remedial alternative involves off-site treatment which would totally reduce the toxicity, mobility and volume of hazardous contaminants from the NL site. No secondary waste management would be required on site except for some water from the decontamination of equipment and personnel. This alternative would result in overall protection of human health and the environment.

Compliance With ARARs

This alternative would meet all the associated contaminant-, action- and location-specific ARARs identified. The removal of contaminated standing water from the site would meet the associated contaminant-specific ARARs identified in Table 4-7. The collection, packaging and transportation of contaminated standing water for off-site treatment and disposal would be in compliance with the associated action-specific ARARs identified in Table 4-8. This alternative would also meet the location-specific ARARs identified in Table 4-9.

Long-Term Effectiveness

The removal of contaminated standing water and sediments from the site would reduce the potential human health risks associated with direct contact and the migration of contaminants into surface water and groundwater. Cleaning and unplugging of drains would prevent ponding of water in the future. Following the remediation, the site would not require further maintenance and monitoring.

Reduction of Toxicity, Mobility or Volume Through Treatment

Removal, off-site treatment and disposal constitute a permanent remedy. Inorganic contaminants in the standing water would be treated and disposed of in RCRA-permitted treatment and disposal facility. Hence this treatment alternative would eliminate the toxicity, mobility and volume of contaminants at the site. In addition, further contamination of surface water and groundwater would be eliminated.

Short-Term Effectiveness

The potential public health threats to workers and area residents would include direct contact with and ingestion of contaminated standing water during pumping and handling. There would not be any secondary waste generated on site because treatment would be done off site. The area would be secured and access would be restricted to authorized personnel.

The risk to workers would be minimized by the use of adequate preventive measures to prevent direct contact with contaminated standing water. All site activities would be in accordance with a site-specific Health and Safety Plan.

The short-term impacts on the environment would be due to an increase in traffic and noise pollution resulting from hauling of contaminated standing water and sediments to an off-site treatment and disposal facility. Transportation of contaminated standing water and sediments may introduce short-term risks with the possibility of spillage along the transport route. A traffic control plan would be implemented with the assistance of local authorities to minimize potential traffic problems. A total period of six months is estimated for this remedial alternative for design, bidding, contractor selection, procurement of off-site treatment and disposal facilities, and collection, transportation, treatment and disposal. The actual remediation period is estimated to be three months.

Implementability

o Technical Feasibility

All the components of this remedial alternative are well developed and commercially available; however, the available capacity of off-site treatment and disposal facilities could be a potential problem since there are only a few facilities currently in operation in the country. Furthermore, the contaminated standing water and sediments would have to undergo a series of analyses prior to acceptance for treatment at the off-site facility. Sufficient land is available at the site for staging tanker trucks or rail cars for collection and transportation of contaminated standing water. Removal to an off-site treatment facility could be done without any difficulty.

o Administrative Feasibility

Implementation of this alternative would require restriction of public access to the site during the remediation process. Contractual procurement of off-site storage, treatment and disposal facilities to handle the type and volume of water and sediments on site would be required. Coordination with State and local agencies would also be required. The transportation of contaminated water to an off-site facility would require appropriate permits and coordination with the Department of Transportation (DOT) and the local traffic department. Traffic control plans would be required before remediation. Manifestation would be required for transportation of contaminated water and sediments. The off-site treatment, storage and disposal facility would have to be in compliance with appropriate permit conditions such as RCRA.

o Availability of Services and Materials

There are a number of treatment, storage and disposal facilities which can treat water with metal contaminants found at NL site. However, the available capacity is limited. Collection and transportation utilize common equipment and should not pose any problems.

Cost

Total capital cost of this alternative is estimated at \$993,200. No operation and maintenance will be required for this alternative. Therefore present worth will be the same as capital cost. Detailed supportive data used to arrive at these estimates are presented in Table A-9 of Appendix A and Table B-9 of Appendix B.

5.5 COMPARISON AMONG REMEDIAL ALTERNATIVES

The following subsection compares the relative performance of each remedial alternative using the specific evaluation criteria presented in Section 5.1. Comparisons are presented in a qualitative manner, and will attempt to identify substantive differences between the alternatives. As with the detailed evaluation, the following criteria are used for the comparative analysis.

- o Overall protection of human health and the environment
- o Compliance with ARARs
- o Long-term effectiveness
- o Reduction of toxicity, mobility or volume through treatment
- o Short-term effectiveness
- o Implementability
- o Cost

5.5.1 Comparison Among Slag and Lead Oxide Piles (SP) Remedial Alternatives

This subsection compares the relative performance of each slag and lead oxide remedial alternative using the specific evaluation criteria listed above. A summary of the detailed analyses of these alternatives is presented in Table 5-1.

Overall Protection of Human Health and the Environment

Alternative SP-1 does not meet the remedial objectives, thus it is not protective of human health and the environment. Surface water and groundwater and soils would be further contaminated due to migration of contaminants from slag and lead oxide piles. Alternative SP-3 would meet remedial objectives by removing the hazardous slag and lead oxide materials from the site. Alternative SP-4 would meet remedial objectives by leaching contaminants from the slag and lead oxide piles. Alternative SP-5 would meet remedial objectives by binding contamination into a insoluble matrix. Alternatives SP-4 and SP-5 would place the treated material on site in accordance with RCRA treatment standards. For cost estimation purposes, it was assumed that the on-site placement would meet RCRA Subtitle D requirements, although the actual disposal requirements would be defined in design, pending treatability studies. Long-term monitoring would be required for Alternatives SP-4 and SP-5.

Compliance with ARARs

Alternative SP-1 would fail to comply with all the associated contaminant-specific ARARs but would comply with the action-specific ARARs.

All removal and/or treatment technologies proposed for use in Alternatives SP-3, SP-4 and SP-5 would be designed and implemented to satisfy all contaminant-specific, location-specific and action-specific ARARs. Alternatives SP-3, SP-4 and SP-5 are designed to render treated materials nonhazardous according to the TCLP. Some uncertainty exists for Alternative SP-4 to meet all contaminant-specific ARARs due to the presence of multiple contaminants.

Long-Term Effectiveness

Alternative SP-1 would only monitor the migration of the contaminants and does not provide removal and/or treatment. Therefore, it is not effective for the long-term protection of human health and the environment.

Alternatives SP-3, SP-4 and SP-5 would mitigate the hazards by total removal and/or treatment and disposal of slag and lead oxide materials.

TABLE 5-1

SUMMARY OF REMEDIAL ALTERNATIVES FOR SLAG AND LEAD OXIDE MATERIALS

Criteria	Alternative SP-1 No Action	Alternative SP-3 Off-Site Flame Reactor	Alternative SP-4 On-Site Hydro-Metallurgical Leaching/On-Site Disposal
Key Components	Long-term monitoring 5-year reviews. Public awareness and education programs.	Off-site treatment of 9,800 and 200 cy of slag material and lead oxide material, respectively, at a RCRA per- mitted flame reactor facility. Possibly recycle treated material as fill material or road aggregate.	On-site treatment of 9,800 and 200 cy of slag material and lead oxide material, respectively, using a hydrometallurgical leaching process. TCLP testing of treated material, followed by on-site disposal in protective manner in accordance with RCRA treatment standards.
1. <u>Overall Protection of Human Health and the Environment</u>	There is essentially no reduc- tion in toxicity, mobility or volume of contaminants. Contaminant migration is monitored but risk is not reduced. Migration of contaminants from the slag and lead oxide mater- ials to the surface water, groundwater, soil and air would continue. This alternative does not meet any of the remedial objectives and therefore is not protective of human health and the environment.	The removal and treat- ment of the slag and lead oxide materials would reduce the toxicity, mobility and volume of hazardous contaminants in the materials, thereby significantly reducing the potential risks to human health and the environment. Results in overall, permanent protection of human health and the environment.	May reduce the public health and environmental risks associated with concerned exposure pathways, and may result in overall protection of human health and the environment. The uncertainty associated with this alterna- tive exists due to the pre- sence of multiple metals. Technology never used on these types of materials. Treatability studies would be performed to determine if treatment objectives can be achieved.
2. <u>Compliance with ARARs</u>			
o Contaminant-specific ARARs	Would not comply Contaminants remain on-site.	Would comply. Removes slag and lead oxide materials from the site.	May comply. Some uncertainty exists due to multiple contaminants.
o Action-specific ARARs	Would comply with ARARs associated with monitoring.	Would comply with all action-specific ARARs.	Would comply with all action- specific ARARs
o Location-specific ARARs	Would not comply	Would comply	Would comply

TABLE 5-1

SUMMARY OF REMEDIAL ALTERNATIVES FOR SLAG AND LEAD OXIDE MATERIALS

Criteria	Alternative SP-1 No Action	Alternative SP-3 Off-Site Flame Reactor	Alternative SP-4 On-Site Hydro-Metallurgical Leaching/On-Site Disposal
3. Long-Term Effectiveness			
o Magnitude of residual risks	Source would not be removed or treated. Existing risk would essentially remain. Natural attenuation is very slow process for type of contaminants involved and would lead to surface and groundwater contamination.	Slag and lead oxide materials would be removed and treated off-site, therefore, no residual risk remains.	After remediation is completed there are minimal remaining risks.
o Adequacy of controls	Potential exposures remain the same.	Flame reactor technology is proven for electric furnace dust, but being tested for CERCLA waste.	Treatability studies would be performed to test if treatment objectives can be achieved. Assuming these objectives can be met, then these technologies would adequately handle these types of contaminants.
o Reliability of Control	Monitoring program is reliable to assess contaminant migration.	These operations are considered reliable for handling metal wastes.	Assuming treatability studies show that treatment objectives could be met, then these technologies would be reliable processes for handling the slag and lead oxide materials. Some uncertainty associated with multiple contaminants.
4. Reduction of Toxicity, Mobility and Volume Through Treatment			
o Treatment process and remedy	No treatment employed, conditions (toxicity, mobility and volume of contaminant) remain the same.	Slag and lead oxide materials would be eliminated as a source of contamination.	Same as Alternative SP-3, assuming treatability studies show that treatment objectives would be met.
o Amount of hazardous material destroyed or treated.	None by treatment. Natural attenuation continues to take place.	Approximately 9,800 and 200 cy of slag and lead oxide material, respectively removed and treated off site.	Approximately 9,800 and 200 cy of slag and lead oxide materials removed and treated assuming treatability studies demonstrate that treatment objectives could be met.
o Reduction of toxicity, mobility and volume (TMV).	None by treatment.	Complete reduction of toxicity, mobility and volume of contaminants in slag and lead oxide material.	Same as Alternative SP-3 assuming treatability studies demonstrate that treatment objectives could be met.

TABLE 5-1

SUMMARY OF REMEDIAL ALTERNATIVES FOR SLAG AND LEAD OXIDE MATERIALS

Criteria	Alternative SP-1 No Action	Alternative SP-3 Off-Site Flame Reactor	Alternative SP-4 On-Site Hydro-Metallurgical Leaching/On-Site Disposal
4. <u>Reduction of Toxicity, Mobility and Volume Through Treatment (Cont'd)</u>			
o Irreversibility of treatment	No treatment involved.	Treatment process is irreversible.	Treatment process is irreversible.
o Type and quantity of treatment residues	All the contaminants remain on site.	No treatment residues on site. Treated slag and lead oxide could possibly be recycled.	Minimal contaminated residues remain in treated residues. Treated residue is expected to pass TCLP.
5. <u>Short-Term Effectiveness</u>			
o Protection of community during remedial actions	Short-term risk to community is not applicable since no remedial action involved.	Temporary increase in direct contact risks and inhalation of fugitive dust to community. Dust control measures would be provided.	Same as Alternative SP-3. In addition, increased risk due to use of chemicals in on-site treatment.
o Protection of workers during remedial actions	No significant short-term risk.	Increased risk of dermal contact and inhalation of dust to workers. However personal protective equipment would be provided.	Same as Alternative SP-3, only slightly increased risk due to performance of treatment on site.

TABLE 5-1

SUMMARY OF REMEDIAL ALTERNATIVES FOR SLAG AND LEAD OXIDE MATERIALS

Criteria	Alternative SP-1 No Action	Alternative SP-3 Off-Site Flame Reactor	Alternative SP-4 On-Site Hydro-Metallurgical Leaching/On-Site Disposal
o Environmental impacts	Continued contamination of surface water, groundwater, soils and air from existing conditions.	Increase in traffic, noise and dust due to remedial activities. Erosion and sediment control measures would be provided to minimize contaminant migration during remedial activities. In addition, potential accidents and spillage would exist during off-site transport of contaminated material.	Same as Alternative SP-3, however, slightly less traffic.
o Time until remedial response objectives are achieved	Natural attenuation takes long period of time, over 30 years. It would take 3 months to implement the monitoring and institutional programs.	Overall remediation period is approximately 18 months. Actual remediation period is estimated to be approximately 6 months.	Overall remediation period is approximately 16 months. Actual remediation period is estimated to be 4 months.
6. <u>Implementability</u>			
<u>Technical Feasibility</u>			
o Ability to construct and operate technology	No construction involved. Monitoring wells are already installed.	Technology is being-tested under EPA's SITE Program currently. The vendor envisions a full-scale unit for treating CERCLA waste to be operational in one year. Contaminated slag and lead oxide material would have to undergo a series of analyses prior to acceptance for treatment at an off-site facility.	Easy to implement on-site. Sufficient land is available on site for operation of mobile system. Bench or pilot-scale treatability study would be needed to develop design criteria.

TABLE 5-1

SUMMARY OF REMEDIAL ALTERNATIVES FOR SLAG AND LEAD OXIDE MATERIALS

Criteria	Alternative SP-1 No Action	Alternative SP-3 Off-Site Flame Reactor	Alternative SP-4 On-Site Hydro-Metallurgical Leaching/On-Site Disposal
6. Implementability (Cont'd)			
o Reliability of technology	No treatment technology involved. Monitoring is reliable.	Treatment technology to date is not yet proven for CERCLA waste on a full-scale basis. However, proven for electric arc furnace dust.	Treatment technology is proven and reliable for extracting metals from ores, however, bench- or pilot-scale treatability study required to develop design criteria for slag and lead oxide materials. Treatment technology is not yet proven for CERCLA waste.
o Ease of undertaking additional remedial action, if necessary.	If monitoring indicates that future action is necessary, must go through the FS/ROD process again.	If additional slag and lead oxide material requires treatment, it can be easily removed during remedial activities.	Same as Alternative SP-3. In addition if treatment objectives are not being met, design criteria could be re-evaluated.
o Monitoring Considerations	Long-term monitoring required. Migration/exposure pathways can be monitored.	No monitoring required after remediation is completed.	Long-term monitoring is required due to disposal of treated materials on site.
<u>Administrative Feasibility</u>			
o Coordination with other agencies	Coordination required with appropriate agencies for long time period for monitoring and reviewing site conditions.	Coordination with State and local agencies required. Transportation of the waste to an off-site facility requires coordination with DOT and local traffic department.	Coordination with State and local agencies required.
<u>Availability of Services and Materials</u>			
o Availability of treatment, storage capacity and disposal services.	No treatment, storage or disposal facilities required.	Commercial facility not currently available, although it is expected to be available in a year.	Several vendors can provide mobile treatment units. Sufficient space is available on site for treatment and disposal of treated material.

TABLE 5-1

SUMMARY OF REMEDIAL ALTERNATIVES FOR SLAG AND LEAD OXIDE MATERIALS

Criteria	Alternative SP-1 No Action	Alternative SP-3 Off-Site Flame Reactor	Alternative SP-4 On-Site Hydro-Metallurgical Leaching/On-Site Disposal
o Availability of necessary equipment, specialists and materials.	Equipment and specialists for monitoring and implementing public awareness program are readily available locally.	Only one vendor is available for this technology (at this time), therefore competitive bids may not be available.	All necessary equipment, specialists and materials are readily available from several vendors. However, modified design may be required for materials in question.
o Availability of technologies	None required.	Treatment technology may not be available on full-scale basis at the time of remediation.	Treatment technology is proven and readily available.
7. Costs			
o Total Capital Cost (\$)	0	4,215,100**	2,980,400
o Annual operation and maintenance (O&M) cost (\$/yr)	25,000	0**	17,000
o Present worth* (\$ based on 5.0% discount rate and 30-year period)	439,900	4,215,100**	3,269,500

* Present worth cost includes approximately \$20,000 for Alternative SP-1 and \$10,000 for Alternatives SP-4 for each five-year review and site assessment.

** This cost estimate is based on the assumption that treated materials would be recycled.
Cost may increase if markets are not available and treated material would have to be disposed of.

TABLE 5-1

SUMMARY OF REMEDIAL ALTERNATIVES FOR SLAG AND LEAD OXIDE MATERIALS

Criteria	Alternative SP-5 On-Site Stabilization (Solidification)/ On-Site Disposal
Key Components	On-site stabilization/solidification of 9,800 and 200 cy of slag material and lead oxide material respectively, using mobile treatment system. TCLP testing of treated material. On-site disposal in a protective manner in accordance with RCRA treatment standards.
1. <u>Overall Protection of Human Health and the Environment</u>	Achieves overall protection of human health and the environment by reducing the mobility of the contaminants. Toxicity of contaminants would be reduced due to immobilization in stabilized mass.
2. <u>Compliance with ARARs</u>	
o Contaminant-specific ARARs	Will comply with contaminant-specific ARARs.
o Action-Specific ARARs	Will comply with action-specific ARARs
o Location-Specific ARARs	Will comply
3. <u>Long-Term Effectiveness</u>	
o Magnitude of residual risks	Same as Alternative SP-4
o Adequacy of controls	These technologies are proven methods for handling these types of contaminants.
o Reliability of Control	These operations are reliable processes for handling the slag and lead oxide materials.

TABLE 5-1

SUMMARY OF REMEDIAL ALTERNATIVES FOR SLAG AND LEAD OXIDE MATERIALS

Criteria	Alternative SP-5 On-Site Stabilization (Solidification)/ On-Site Disposal
4. <u>Reduction of Toxicity, Mobility and Volume Through Treatment</u>	
o Treatment process and remedy	Reduction in mobility of inorganic contaminants by stabilization/solidification process.
o Amount of hazardous material destroyed or treated.	Approximately 9,800 and 200 cy of slag and lead oxide material respectively would be removed and treated on-site.
o Reduction of toxicity mobility and volume (TMV).	Mobility of contaminants would be reduced. Reduction of toxicity of contaminants due to immobilization in stabilized mass. Volume of solidified material may increase up to 40 percent depending on additives used.
o Irreversibility of treatment	Treatment process is essentially irreversible over short-term. Long-term irreversibility is not known.
o Type and quantity of treatment residues	Treatment immobilizes contaminants although immobile contaminants remain in treated material.
5. <u>Short-Term Effectiveness</u>	
o Protection of community during remedial actions	Same as Alternative SP-3. In addition, increased dust emissions due to on-site treatment.
o Protection of workers during remedial actions	Same as Alternative SP-4.
o Environmental impacts	Same as Alternative SP-4.
o Time until remedial response objectives are achieved	Overall remediation period is approximately 15 months. Actual remediation time is estimated to be 3 months.

TABLE 5-1

SUMMARY OF REMEDIAL ALTERNATIVES FOR SLAG AND LEAD OXIDE MATERIALS

Criteria	Alternative SP-5 On-Site Stabilization (Solidification)/ On-Site Disposal
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6. ImplementabilityTechnical Feasibility

- | | |
|---|--|
| o Ability to construct and operate technology | Easily implementable on site using mobile treatment units. Sufficient land is available on site for operation of mobile units and disposal of treated materials. |
| o Reliability of technology | Stabilization/solidification technology is reliable for metal-contaminated waste. This technology is widely used for CERCLA waste. |
| o Ease of undertaking additional remedial action, if necessary. | Same as Alternative SP-3. |
| o Monitoring Considerations | Monitoring is required because treated material is disposed of on site. |

Administrative Feasibility

- | | |
|------------------------------------|---------------------------|
| o Coordination with other agencies | Same as Alternative SP-4. |
|------------------------------------|---------------------------|

Availability of Services and Materials

- | | |
|--|---------------------------|
| o Availability of treatment, storage capacity and disposal services. | Same as Alternative SP-4. |
| o Availability of necessary equipment, specialists and materials. | Same as Alternative SP-4. |

TABLE 5-1

SUMMARY OF REMEDIAL ALTERNATIVES FOR SLAG AND LEAD OXIDE MATERIALS

Criteria	Alternative SP-5 On-Site Stabilization (Solidification)/ On-Site Disposal
----------	---

Availability of Services
and Materials (Cont'd)

- | | |
|--------------------------------|---------------------------|
| o Availability of technologies | Same as Alternative SP-4. |
|--------------------------------|---------------------------|

7. Costs

- | | |
|--|-----------|
| o Total Capital Cost (\$) | 2,014,000 |
| o Annual operation and maintenance (O&M) cost (\$/yr) | 17,000 |
| o Present worth* (\$ based on 5.0% discount rate and 30-year period) | 2,303,100 |

* Present worth cost includes approximately \$10,000 for Alternative SP-5 for each five-year review and site assessment.

Some uncertainty exists for Alternative SP-4 which has not been applied to similar CERCLA waste material. Although some long-term uncertainties regarding the integrity of the stabilized mass have been raised, Alternative SP-5 is highly effective in treating metal contamination and will inhibit leaching of contaminants.

Alternatives SP-4 and SP-5 would place treated materials on site in accordance with RCRA treatment standards. For cost estimation purposes, it is assumed that the on-site placement would meet RCRA Subtitle D requirements, although the actual disposal requirements would be defined in design, pending treatability studies. Although treated material may be considered as nonhazardous, it would require long-term monitoring. Alternative SP-3 would be considered a permanent remedy and would not require long-term monitoring.

Reduction of Toxicity, Mobility or Volume Through Treatment

Alternative SP-1 would not provide any immediate reduction in toxicity, mobility and volume. It may provide some reduction in toxicity and volume by natural attenuation, but it would be insignificant. It would not provide any reduction in mobility of contaminants. Alternatives SP-3 and SP-4 would result in significant reductions in the toxicity, mobility and volume. Alternative SP-3 would reduce the toxicity, mobility and volume by removal of contaminated slag and lead oxide materials from the site and off-site treatment and disposal or recycling. Alternative SP-4 would reduce toxicity, mobility and volume by on-site treatment. Alternative SP-5 would reduce the mobility of the contaminants and the toxicity would be reduced in that they would be immobilized in the stabilized mass and no longer present a direct contact threat. Alternatives SP-4 and SP-5 would leave some contaminants on site, but their mobility would be significantly reduced. Alternative SP-5 would result in some volume increase after treatment.

Short-Term Effectiveness

The implementation of Alternative SP-1 should not result in any additional risk to the workers and the community. Alternatives SP-3, SP-4 and SP-5 include activities such as contaminated slag and lead oxide removal, handling, treatment and/or transportation that could result in potential exposure of workers and residents to contaminated dust generated from remedial activities. Alternatives SP-4 and SP-5 involve on-site treatment that reduce the chances of spillage of hazardous waste in transit. However, these alternatives could result in worker exposure to contaminants during treatment. Dust control measures and closed loop treatment systems would significantly reduce these possibilities. Alternative SP-1 would take more than 30 years to achieve complete protection. However a period of 30 years would be used for costing purposes. Periods of 18,

16 and 15 months are estimated for Alternatives SP-3, SP-4 and SP-5 respectively. These estimates include design and testing, selection of a contractor, mobilization, demobilization, and actual remediation period.

Implementability

Alternative SP-1 does not involve any major site activities except monitoring and sampling. These activities can be easily implemented. Alternatives SP-3, SP-4 and SP-5 involve removal and/or treatment of contaminated slag and lead oxide materials from the site. Implementability of Alternative SP-3 depends on the availability of an operating flame reactor facility at the time of remediation. The vendor indicated that a full-scale facility may be in operation in a year. Alternative SP-4 can be easily implemented because the technology is available and proven in the hydro-metallurgical industry, however it has not been used for similar application. Alternative SP-5 can also be implemented easily because the technology is proven for CERCLA waste contaminated with metals. Mobile treatment units are also available.

Cost

The total capital, annual operation and maintenance, and present worth cost for all slag and lead oxide material alternatives are presented in Table 5-1. Alternatives SP-1, SP-4 and SP-5 would require annual operation and maintenance cost. Alternative SP-3 does not require long-term operation and maintenance. Present worths for Alternatives SP-1, SP-4 and SP-5 are based on a discount rate of five percent and a 30-year operation period. Alternative SP-1 is the least expensive alternative. However, it does not involve treatment and disposal. Alternative SP-5 is the least expensive treatment and disposal alternative. Alternative SP-3 is the most expensive treatment and disposal alternative.

5.5.2 Comparison Among Debris and Contaminated Surfaces (Buildings and Equipment) Alternatives

Only two remedial alternatives are evaluated for debris and contaminated surfaces. A summary of the detailed analyses is presented in Table 5-2. The following comparison will attempt to highlight the substantive differences between the two alternatives.

Overall Protection of Human Health and the Environment

Alternative CS-1 leaves contaminated debris and dust on the contaminated surfaces in their current condition. This alternative does not meet the remedial objectives and would not allow safe entry in the future. Human health would be protected as long as the site and building security can be effectively maintained. Environmental risks to birds would not change. In comparison, Alternative CS-2 decontaminates debris and removes it from site for disposal in a Subtitle D landfill. This alternative would also recycle any recyclable materials. Alternative CS-2 also removes contaminated dust from the buildings and equipment surfaces. Therefore, it is fully protective of human health and the environment. In addition, Alternative CS-2 achieves the remedial objectives and allows safe entry into the buildings without chemical risks.

Compliance with ARARs

Alternative CS-1 would not achieve contaminant-specific ARARs. However, it would comply with action-specific and location-specific ARARs. Alternative CS-2 would comply with all the relevant ARARs.

Long-Term Effectiveness

Alternative CS-1 would only maintain the site and buildings in their present conditions. Therefore, debris and contaminated dust on surfaces would remain. Roof repair would prevent water leakage and transport of contaminants. Protection of human health and the environment would rely on maintaining the site and building security which may be difficult to enforce. Alternative CS-2 however, removes all hazardous debris and dust for off-site treatment and disposal. This alternative would also recycle any recyclable materials. Any contaminated water generated from decontamination operations would be removed and treated and/or disposed of with the standing water. This alternative would eliminate long-term exposure risks from the site and the buildings. The buildings could be safely entered after decontamination without risking human health.

Reduction of Toxicity, Mobility or Volume Through Treatment

Alternative CS-1 does not provide any reduction in toxicity or volume. Mobility of contaminants in the buildings is somewhat reduced by repairing the leaky roof. However, mobility of contaminants from debris staged outdoors would remain

TABLE 5-2

SUMMARY OF REMEDIAL ALTERNATIVES FOR DEBRIS AND CONTAMINATED SURFACES

Criteria	Alternative CS-1 No Action	Alternative CS-2 Contaminated Surfaces Decontamination/ Off-Site Treatment and Disposal
Key Components	Restrict building access and use of buildings and equipment. Roof repairs to prevent leakage. Long-term inspection and maintenance program including five-year reviews to assess site conditions.	Decontaminate buildings and equipment via dusting, vacuuming and wiping and send dust for off-site treatment and disposal. Hydroblasting would be used to clean parts of building and this water would then be treated and disposed of with the standing water. Recyclable materials would be recycled.
1. <u>Overall Protection of Human Health and the Environment</u>	Provides protection to human health and the environment as long as the building is locked and its use is prohibited and there is no further significant deterioration.	Provides overall permanent protection to human health and environment.
2. <u>Compliance with ARARs</u>		
o Contaminant-specific ARARs	Would not comply.	Would comply by removing and decontaminating contaminated surfaces and debris.
o Action-specific ARARs	Would comply.	Would comply with all action-specific ARARs.
o Location-specific ARARs	Would comply.	Would comply with all location-specific ARARs.
3. <u>Long-Term Effectiveness</u>		
o Magnitude of residual risks	Source would not be removed or treated, therefore residual risk remains. However, access would be restricted so that risks would be reduced.	No remaining risks after completion of remedial action.
o Adequacy of controls	The long-term maintenance program is designed to maintain the security of the building and is effective in minimizing trespassing.	The building decontamination and off-site treatment and disposal procedures are proven technologies.
o Reliability of Control	Building access control and security are reliable at minimizing access, although susceptible to vandalism.	All technologies are very reliable.
4. <u>Reduction of Toxicity, Mobility and Volume Through Treatment</u>		
o Treatment process and remedy	Locking building and roof repair would reduce mobility of contaminants. Toxicity and volume of contaminants remain unchanged.	Decontamination, off-site treatment and disposal are very effective at reducing toxicity, mobility and volume of contaminants in the buildings.

TABLE 5-2

SUMMARY OF REMEDIAL ALTERNATIVES FOR DEBRIS AND CONTAMINATED SURFACES

Criteria	Alternative CS-1 No Action	Alternative CS-2 Contaminated Surfaces Decontamination/ Off-Site Treatment and Disposal
4. <u>Reduction of Toxicity, Mobility and Volume Through Treatment</u> (Con'td)		
o Amount of hazardous material destroyed or treated.	None by treatment.	All of the contaminated dust (approximately 70 cy) and debris (approximately 2,5000 cy) would be removed, treated and disposed of.
o Reduction of toxicity, mobility and volume (TMV).	Mobility is reduced by containing contaminants within building. Toxicity and volume of contaminants remains unchanged.	Toxicity, mobility and volume of building contaminants would be reduced.
o Irreversibility of treatment	No treatment. If building security is breached, exposure risks increase to current levels.	Treatment is irreversible.
o Type and quantity of treatment residues	No treatment involved.	No treatment residues remain.
5. <u>Short-Term Effectiveness</u>		
o Protection of community during remedial actions	No protection required.	Minimal risks due to increase in dust during remedial action. Safeguards would be implemented to minimize these risks.
o Protection of workers during remedial actions	Applicable OSHA regulations would be observed to prevent workers from normal construction hazards during roof repair.	Applicable OSHA regulations and personnel protective equipment would be used to protect workers during implementation of remedial actions.
o Environmental impacts	No environmental impacts from remedial actions.	No environmental impacts from remedial actions.
o Time until remedial response objectives are achieved	This alternative would not achieve the response objectives. It would take approximately 1 month to secure the buildings.	Time required to achieve response objectives is approximately 12 months. Actual remediation period is estimated to be 3 months.
6. <u>Implementability</u>		
<u>Technical Feasibility</u>		
o Ability to construct and operate technology	Sealing of building is easily implemented.	Dusting, vacuuming, wiping and hydroblasting technologies are easily implemented. Several off-site treatment and disposal facilities can handle the contaminated materials.
o Reliability of technology	Building access control and security techniques are reliable technologies. However, they could be breached by vandalism.	All technologies employed in this alternative are reliable.

TABLE 5-2

SUMMARY OF REMEDIAL ALTERNATIVES FOR DEBRIS AND CONTAMINATED SURFACES

Criteria	Alternative CS-1 No Action	Alternative CS-2 Contaminated Surfaces Decontamination/ Off-Site Treatment and Disposal
6. Implementability		
<u>Technical Feasibility (Cont'd)</u>		
o Ease of undertaking additional remedial action, if necessary.	If monitoring indicates that future action is necessary, must go through the FS/ROD process again.	If additional contaminated surfaces are found during remedial action, they can be decontaminated at that time.
o Monitoring Considerations	Monitoring and 5-year reviews are required because contaminants remain on site.	No monitoring required after remedial actions are completed.
<u>Administrative Feasibility</u>		
o Coordination with other agencies	Coordination required with appropriate agencies for long time period for monitoring and reviewing site conditions.	Coordination required with DOT and local traffic authorities for transporting the contaminated dust to the off-site treatment and disposal facility.
<u>Availability of Services and Materials</u>		
o Availability of treatment, storage capacity and disposal services.	No treatment, storage or disposal facilities are required.	All of these services are available from several vendors.
o Availability of necessary equipment, specialists and materials.	Equipment and specialists for sealing building and for monitoring are readily available.	Equipment and specialists for performing the decontamination are readily available. Several RCRA-permitted facilities can accept the contaminated dust and water for off-site treatment and disposal.
o Availability of technologies	None required.	All technologies are proven and readily available from several sources.
7. Costs		
o Total Capital Cost (\$)	17,700	1,691,100
o Annual Operation and Maintenance (O&M) Cost (\$/yr)	6,800	0
o Present Worth* (\$ based on 5.0% discount rate and 30-year period)	136,100	1,691,100

* Present worth cost includes approximately \$5,000 for Alternative CS-1 for each five-year review and site assessemnt.

unaltered. Alternative CS-2 provides for complete reduction in toxicity and volume, since all contaminants are removed from the site.

Short-Term Effectiveness

Alternative CS-1 would not result in any additional risk to the workers, community or the environment as long as building security and integrity could be maintained. Roof repair would not introduce additional risk. Alternative CS-2 involves removal and transport of contaminants from the site. Therefore, there are some potential public exposure risks as well as environmental impacts associated with possible transport accidents. Worker exposure risk increases during decontamination activities associated with Alternative CS-2. These risks would be mitigated by protective equipment and strict adherence to the site-specific Health and Safety Plan. Alternative CS-1 would require long-term maintenance. Alternative CS-2 would be considered a permanent remedy and would not require any maintenance. Roof repair for Alternative CS-1 could take approximately one month. Building decontamination could be accomplished in approximately three months for Alternative CS-2. However, a period of one year is estimated for design, bidding, selection of a contractor, mobilization, demobilization, and actual decontamination time.

Implementability

Alternative CS-1 can be easily implemented. It does not involve any major activities. This alternative would require monitoring, roof repair, and maintenance of security. Alternative CS-2 would require extensive decontamination. Multiple technologies such as dusting, vacuuming, wiping and hydroblasting would be utilized depending on the area of the building and surfaces to be decontaminated. Some parts of the buildings, such as walkways and stairs, are structurally weak and would require proper assessment before using high pressure washing techniques such as hydroblasting. Areas of the building such as kiln burner building, feed building and decasing building walls and roofs with asbestos would not be subjected to hydroblasting. All technologies associated with Alternative CS-2 are commercially available and commonly used for cleaning and decontamination applications. Collected dust and wipe cloths could be treated and disposed of in RCRA Subtitle C disposal facilities, whereas decontaminated debris may be disposed of in a Subtitle D landfill.

Cost

The total capital, annual operation and maintenance, and present worth costs for both alternatives are presented in Table 5-2. Alternative CS-2 would not incur annual operation and maintenance cost. Present worth cost for Alternative CS-1 is based on a five percent discount rate and 30-year period. Alternative CS-1 is less expensive than Alternative CS-2. However, it would not involve any treatment.

5.5.3 Comparison Among Standing Water and Sediment (SW) Remedial Alternatives

This subsection compares the relative performance of each standing water and sediment remedial alternative using the specific evaluation criteria presented in Section 5.1. A summary of the detailed analyses of these alternatives is presented in Table 5-3.

Overall Protection of Human Health and the Environment

Alternative SW-1 would not provide protection of human health and the environment. Contaminated standing water and sediments on the site would continue to contaminate surface water and groundwater. Alternatives SW-2 and SW-3 would be protective of human health and the environment and achieve remedial objectives because contaminated water and sediments would be removed from the site and treated and/or disposed. These alternatives would result in reduction of toxicity, mobility and volume of contaminants. Alternative SW-2 would involve on-site treatment and disposal. Treated water would meet groundwater discharge requirements. Secondary wastes generated from treatment along with sediments removed from the site would be disposed of at an off-site treatment and disposal facility. Alternative SW-3 would remove contaminated surface water and sediments and disposed of in an off-site, RCRA-permitted facility.

Compliance with ARARs

Alternative SW-1 would not comply with contaminant-specific ARARs. It would however comply with associated action-specific and location-specific ARARs.

Alternative SW-2 would be designed to achieve contaminant-specific ARARs for groundwater recharge. This alternative would be implemented so as to achieve relevant action-specific and location-specific ARARs.

Alternative SW-3 would meet contaminant-specific requirements. Action-specific and location-specific ARARs would also be met.

Long-Term Effectiveness

Alternative SW-1 would not provide removal or treatment but would provide site access restrictions. However, this would not prevent further contamination of surface water and groundwater.

Alternative SW-2 would eliminate potential risks associated with direct contact and ingestion of contaminated standing water and sediments. This alternative would also prevent further contamination of surface water and groundwater.

Alternative SW-3 would eliminate the future threat of on-site exposure and off-site contaminant migration and would be permanent and effective in protecting the human health and the environment.

TABLE 5-3

SUMMARY OF REMEDIAL ALTERNATIVES FOR STANDING WATER AND SEDIMENTS

Criteria	Alternative SW-1 No Action	Alternative SW-2 On-Site Treatment and Groundwater Recharge	Alternative SW-3 Off-Site Treatment and Disposal
Key Components	Long-term monitoring and 5-year reviews. Public awareness and education program.	Standing water and sediments would be collected and treated for metals removal via chemical precipitation, flocculation, and filtration. Ion exchange would be used, if necessary. The treated water would then be recharged to groundwater via injection wells or infiltration basins. Drains would be decontaminated and unplugged.	Collection of standing water and sediments, and transport to a RCRA permitted treatment and disposal facility. Drains would be decontaminated and unplugged.
1. <u>Overall Protection of Human Health and the Environment</u>	Essentially no reduction in toxicity, mobility or volume of hazardous contaminants in the standing water. Risk from contaminant migration is monitored but not reduced. Does not meet the remedial objectives for the site and therefore does not provide protection to human health or the environment.	This alternative would remove and treat the contaminated water thereby eliminating all human health and environmental risks associated with the standing water, resulting in overall permanent protection to human health and the environment.	Same as Alternative SW-2
2. <u>Compliance with ARARs</u>			
o Contaminant-specific ARARs	Would not comply. Would leave contaminated water and sediments on site.	Would comply because removes contaminated water and sediments and treats to discharge standards.	Would comply by removing contaminated water from the site.
o Action-specific ARARs	Would comply.	Would comply with action-specific ARARs.	Same as Alternative SW-2.
o Location-specific ARARs	Would not comply.	Would comply with all location-specific ARARs.	Same as Alternative SW-2.

TABLE 5-3

SUMMARY OF REMEDIAL ALTERNATIVES FOR STANDING WATER AND SEDIMENTS

Criteria	Alternative SW-1 No Action	Alternative SW-2 On-Site Treatment and Groundwater Recharge	Alternative SW-3 Off-Site Treatment and Disposal
3. Long-Term Effectiveness			
o Magnitude of residual risks	Standing water and sediments would not be treated or removed. Existing risk will essentially remain. Natural attenuation is a very slow process.	No residual risks to public health or the environment remain after remedial action is completed.	Same as Alternative SW-2.
o Adequacy of controls	No remedial actions and therefore potential exposures remain the same.	These technologies are proven methods for handling these types of contaminants.	Same as Alternative SW-2.
o Reliability of Control	Monitoring program is reliable to assess contaminant migration.	These operations are reliable processes for handling the contaminated standing water and sediments.	Same as Alternative SW-2.
4. Reduction of Toxicity, Mobility and Volume Through Treatment			
o Treatment process and remedy	No treatment employed, conditions (toxicity, mobility and volume of contaminants) remain the same. Volume of contaminated standing water and sediments may increase.	Significant overall reduction in toxicity, mobility and volume of contaminants of concern in standing water and sediments.	Totally eliminates the toxicity, mobility and volume of all contaminants of concern in standing water and sediments at the site.
o Amount of hazardous material destroyed or treated.	None by treatment.	All standing water containing contaminants in excess of cleanup levels and approximately 200 cy of sediments underlying the standing water.	Same as Alternative SW-2.
o Reduction of toxicity, mobility and volume (TMV).	None by treatment.	Toxicity, mobility and volume of contaminated standing water significantly reduced.	Toxicity, mobility and volume of contaminated standing water at the site would be eliminated.

TABLE 5-3

SUMMARY OF REMEDIAL ALTERNATIVES FOR STANDING WATER AND SEDIMENTS

Criteria	Alternative SW-1 No Action	Alternative SW-2 On-Site Treatment and Groundwater Recharge	Alternative SW-3 Off-Site Treatment and Disposal
4. <u>Reduction of Toxicity, Mobility and Volume Through Treatment (Cont'd)</u>			
o Irreversibility of treatment	No treatment involved.	Treatment is irreversible.	Same as Alternative SW-2.
o Type and quantity of treatment residues	No treatment involved.	Sludge would be generated and disposed of off-site. Total quantity of sludge and sediment is estimated to be 358 tons.	No treatment residue remains on site.
5. <u>Short-Term Effectiveness</u>			
o Protection of community during remedial actions	No short-term risks to community.	Minimal short-term risks	Same as Alternative SW-2.
o Protection of workers during remedial actions	No significant short-term risk. Personnel protection equipment would be used during sampling activities.	Applicable OSHA regulations, would be followed. Personnel protective equipment would be provided for workers.	No significant short-term risk. Personnel protective equipment would be provided to prevent direct contact with contaminated water and sediments.
o Environmental impacts	No short-term risks during implementation of this alternative.	No major environmental impacts during implementation of this remedial alternative.	Increased traffic and noise pollution resulting from hauling of contaminated water and sediments to off-site treatment facility. Possibility of spillage along the transport route.
o Time until remedial response objectives are achieved	Natural attenuation takes long period of time, over 30 years. It would take 3 months to implement the monitoring and institutional programs.	Overall remediation period is approximately 14 months. Actual remediation period is approximately 3 months.	Overall remediation period is approximately 6 months. Actual remediation period is approximately 3 months.

TABLE 5-3

SUMMARY OF REMEDIAL ALTERNATIVES FOR STANDING WATER AND SEDIMENTS

Criteria	Alternative SW-1 No Action	Alternative SW-2 On-Site Treatment and Groundwater Recharge	Alternative SW-3 Off-Site Treatment and Disposal
6. Implementability			
<u>Technical Feasibility</u>			
o Ability to construct and operate technology	No construction involved. Monitoring program can be easily implemented.	Easy to construct and operate all aspects of this technology.	Availability of off-site treatment facilities may be potential problem.
o Reliability of technology	No treatment technology involved. Monitoring is reliable.	All aspects of this technology are very reliable.	Same as Alternative SW-2.
o Ease of undertaking additional remedial action, if necessary.	If monitoring indicates that future action is necessary, must go through the FS/ROD process again.	If found necessary, additional water could be treated using this facility.	Same as Alternative SW-2 assuming facility can handle additional volume of water.
o Monitoring Considerations	Long-term monitoring required. Migration/exposure pathways can be monitored.	No monitoring required after completion of remedial actions.	Same as Alternative SW-2.
<u>Administrative Feasibility</u>			
o Coordination with other agencies	Coordination required with appropriate agencies for long time period for monitoring and reviewing site conditions.	Coordination required with EPA, DOT and State agencies during remedial actions.	Same as Alternative SW-2. In addition coordination required with local traffic authorities.
<u>Availability of Services and Materials</u>			
o Availability of treatment, storage capacity and disposal services.	No treatment, storage or disposal facilities required.	All of these technologies are proven and readily available.	All these technologies are proven, however facility availability may be limited.

TABLE 5-3

SUMMARY OF REMEDIAL ALTERNATIVES FOR STANDING WATER AND SEDIMENTS

Criteria	Alternative SW-1 No Action	Alternative SW-2 On-Site Treatment and Groundwater Recharge	Alternative SW-3 Off-Site Treatment and Disposal
6. <u>Implementability</u> (Cont'd)			
o Availability of necessary equipment, specialists and materials.	Equipment and specialists for monitoring and implementing public awareness program are readily available locally.	Several vendors can provide all necessary equipment, specialists and materials.	Facility availability may be limited.
o Availability of technologies	None required.	Technologies are commercially available from several vendors.	Technologies are readily available. Facilities may be limited.
7. <u>Costs</u>			
o Total Capital Cost (\$)	0	1,335,000	993,200
o Annual operation and maintenance (O&M) cost (\$/yr)	10,700	0	0
o Present worth* (\$ based on 5.0% discount rate and 30 year period)	220,100	1,335,000	993,200

* Present worth cost includes approximately \$20,000 for Alternative SW-1 for each five-year review and site assessment.

Reduction of Toxicity, Mobility or Volume Through Treatment

Alternative SW-1 would not involve any removal, treatment or disposal of the contaminated standing water and sediments and therefore, would not be effective in reduction of toxicity, mobility or volume.

Alternatives SW-2 and SW-3 would effectively reduce the toxicity, mobility and volume because these alternatives involve complete removal of contaminated standing water ponded throughout the site and in the basement of the refining building. These alternatives would also remove sediments underlying the standing water.

Short-Term Effectiveness

The implementation of Alternative SW-1 would not result in additional risk to the workers and the community since no major remedial activities would be conducted. Alternatives SW-2 and SW-3 involve collection, treatment, and/or disposal of contaminated standing water and sediments. Alternative SW-2 would involve on-site treatment and disposal thereby require chemical handling and handling of secondary wastes generated. These activities would involve additional risk to workers.

Proper health and safety measures would be required during these activities. Off-site disposal of secondary wastes generated during treatment and sediments in Alternative SW-2 and transportation of contaminated water and sediments in Alternative SW-3 would introduce some risk to the community from possible spillage during transit. Coordination with local traffic authorities would be required for these alternatives. Alternative SW-1 would take more than 30 years to achieve complete protection. However, a period of 30 years would be used for costing purposes. A period of fourteen months is estimated for Alternative SW-2. This estimate includes design and testing, bidding, contractor selection, mobilization, demobilization, and actual remediation time. Alternative SW-3 would require six months to achieve complete protection.

Implementability

All components of Alternative SW-1 would be easily implemented. This alternative simply requires access restrictions, monitoring and public education programs. Alternative SW-2 would utilize relatively common treatment technologies and materials and is available from a number of vendors. Alternative SW-3 utilizes off-site treatment and disposal. There are only a few off-site treatment and disposal facilities available for aqueous waste treatment.

Cost

The total capital, annual operation and maintenance and present worth costs for all standing water and sediment remedial alternatives are presented in Table 5-3. Only Alternative SW-1 would require annual operation and maintenance cost. Present worth is based on a discount rate of five percent and 30-year period. Alternatives SW-2 and SW-3 would not involve operation and maintenance cost. Alternative SW-1 is the least expensive but it does not involve any treatment. Alternative SW-2 is the most expensive standing water remedial alternative. Alternative SW-3 is less expensive alternative involving treatment and disposal.

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APPENDIX A

LIST OF MAJOR FACILITIES AND CONSTRUCTION
COMPONENTS FOR REMEDIAL ALTERNATIVES

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TABLE A-1

ALTERNATIVE SP-1: NO ACTION

MAJOR FACILITIES AND CONSTRUCTION COMPONENTS

<u>ITEM</u>	<u>ESTIMATED QUANTITIES</u>	<u>DESCRIPTION</u>
No Additional Actions Required.		

TABLE A-2

ALTERNATIVE SP-3: OFF-SITE FLAME REACTOR

MAJOR FACILITIES AND CONSTRUCTION COMPONENTS

<u>ITEM</u>	<u>ESTIMATED QUANTITIES</u>	<u>DESCRIPTION</u>
1. Office and Decontamination Trailer	1	Lease for six months. Office and health and safety trailer with shower facilities including site preparation, setup, utilities decontamination water storage and disposal etc. Size 30 ft L x 7.5 ft W x 7 ft H
2. Bench/Pilot Scale Treatability Test	Lump Sum	Treatability test to optimize process conditions.
3. Removal and Handling	10,000 cy (12,000 tons)	Removal of slag and lead oxide materials and loading.
4. Transportation	12,000 tons	Transportation to off-site treatment facility (Assume 200 mile distance).
5. Flame Reactor Treatment	12,000 tons	Flame reactor treatment including secondary waste management (Horsehead Resource Development or equivalent).
6. Recycling and disposal of residues	12,000 tons	Recycling metal oxides and treated slag.
7. Health and Safety	Lump Sum	Health and Safety equipments and monitoring.

TABLE A-3

ALTERNATIVE SP-4: ON-SITE HYDRO-METALLURGICAL LEACHING/ON-SITE DISPOSAL

MAJOR FACILITIES AND CONSTRUCTION COMPONENTS

<u>ITEM</u>	<u>ESTIMATED QUANTITIES</u>	<u>DESCRIPTION</u>
1. Office Trailer	2	Lease for six months. 1 for EPA, NJDEP and Engineering office, 1 for contractor office and equipments. Size 30 ft L x 7.5 ft W x 7 ft H.
2. Decontamination Trailer	1	Lease for six months. Health and safety trailer with shower facility including site preparation, set up, utilities, decon water storage and disposal. Size 30 ft L x 7.5 ft W x 7 ft H.
3. Bench/Pilot Scale Treatability Test	Lump Sum	Treatability test to optimize process conditions.
4. Mobilization/Demobilization	Lump Sum	Mobilization, set up and demobilization of treatment system.
5. Removal and Handling	10,000 cy	Removal, preparation, and staging slag and lead oxide materials including loading into hydro-metallurgical leaching plant. Treatment rate 100 cy per day.
6. Hydro-metallurgical Leaching	10,000 cy	Hydro-metallurgical leaching including testing, monitoring, chemicals and secondary waste management. (Pittsburgh Mineral and Environmental Technology or equivalent).
7. Recycle Recovered Lead	1,250 tons	Recycle recovered lead (Assumed 10% lead in slag and 35% lead in lead oxide).
8. Disposal	10,000 cy	On-site disposal of treated non-hazardous material.
9. Health and Safety	Lump Sum	Health and Safety equipments and monitoring.

TABLE A-4

ALTERNATIVE SP-5: ON-SITE STABILIZATION (SOLIDIFICATION)/ON-SITE DISPOSAL

MAJOR FACILITIES AND CONSTRUCTION COMPONENTS

<u>ITEM</u>	<u>ESTIMATED QUANTITIES</u>	<u>DESCRIPTION</u>
1. Officer Trailer	2	Lease for six months. 1 for EPA, NJDEP and Engineering office, 1 for contractor office and equipments. Size 30 ft L x 7.5 ft W x 7 ft H.
2. Decontamination Trailer	1	Lease for six months. Health and Safety trailer with shower facility including site preparation, set up, utilities, decontamination water storage and disposal. Size 30 ft L x 7.5 ft W x 7 ft H.
3. Mobilization/Demobilization	Lump Sum	Mobilization, set up and demobilization of treatment system.
4. Bench/Pilot Scale Treatability Test	Lump Sum	Treatability test to optimize process conditions.
5. Removal and Handling	10,000 cy	Removal, preparation and staging slag and lead oxide materials including loading into stabilization/solidification system. Assume treatment rate 200 cy per day.
6. On-Site Stabilization/Solidification	10,000 cy	Including testing, monitoring, feed preparation, additives and secondary waste management (Chemfix, Hazcon, Maecorp or equivalent).
7. Disposal	14,000 cy	On-site disposal of treated non-hazardous material.
8. Health and Safety	Lump Sum	Health and Safety equipments and monitoring.

TABLE A-5

ALTERNATIVE CS-1: NO ACTION

MAJOR FACILITIES AND CONSTRUCTION COMPONENTS

<u>ITEM</u>	<u>ESTIMATED QUANTITIES</u>	<u>DESCRIPTION</u>
1. Building Roof Repair	13,100 ft ²	Inspection of building roof and repairing leaks.

TABLE A-6

ALTERNATIVE CS-2: DEBRIS AND CONTAMINATED SURFACES (BUILDINGS AND EQUIPMENTS) DECONTAMINATION/OFF-SITE TREATMENT AND DISPOSAL

MAJOR FACILITIES AND CONSTRUCTION COMPONENTS

<u>ITEM</u>	<u>ESTIMATED QUANTITIES</u>	<u>DESCRIPTION</u>
1. Office Trailer	2	Lease for six months. 1 for EPA, NJDEP and Engineering office, 1 for contractor office and equipments. Includes set up, site preparation, utilities, decontamination water storage and disposal. Size 30 ft L x 7.5 ft W x 7 ft H.
2. Decontamination Trailer	1	Lease for six months. Health and Safety trailer with shower facility. Size 30 ft L x 7.5 ft W x 7 ft W.
3. Building Roof Repair	13,100 ft ²	Inspection and repair of deteriorated leaking roof.
4. Dusting/vacuuming/wiping	40,000 sy	Removal of dust from floors, walls, ceiling including testing.
5. Hydroblasting	20,000 sy	Decontamination of some areas of building, equipments, pavements and debris.
6. Off-site Treatment and Disposal of Dust	70 cy (85 tons)	Off-site transportation, treatment and disposal of contaminated dust at a RCRA permitted facility.
7. Treatment/Disposal of Water from Hydroblasting	810,000 gallons	Collection, treatment and disposal of water resulting from hydroblasting (Assume 100 mile distance).
8. Off-site Disposal of Decontaminated Debris	1000 cy	Transportation and disposal of decontaminated debris at off-site subtitle D landfill (Assume 100 mile distance).
9. Health and Safety	Lump Sum	Health and Safety equipments and monitoring.

TABLE A-7

ALTERNATIVE SW-1: NO ACTION

MAJOR FACILITIES AND CONSTRUCTION COMPONENTS

ITEM

ESTIMATED QUANTITIES

DESCRIPTION

No Additional Actions Required.

TABLE A-8

ALTERNATIVE SW-2: ON-SITE TREATMENT AND GROUNDWATER RECHARGE

MAJOR FACILITIES AND CONSTRUCTION COMPONENTS

<u>ITEM</u>	<u>ESTIMATED QUANTITIES</u>	<u>DESCRIPTION</u>
1. Office Trailer	2	Lease for six months. 1 for EPA, NJDEP and Engineering office, 1 for contractor office and equipments. Includes site preparation, set up, utilities, decontamination water storage and disposal. Size 30 ft L x 7.5 ft W x 7 ft H.
2. Decontamination Trailer	1	Lease for six months. Health and safety trailer with shower facility.
3. Mobilization/Demobilization	Lump Sum	Mobilization, set up and demobilization of treatment system.
4. Bench/Pilot Scale Treatability Test	Lump Sum	Treatability test for optimizing treatment process.
5. Pumping and Collection	1,000,000 gallons	Pumping and collection of 1,000,000 gallons of ponded water into a day tank.
6. pH Adjustment, Chemical Precipitation, Flocculation, Clarification, Filtration	1,000,000 gallons	On-site aqueous waste treatment including pH adjustment, sulfide precipitation, coagulation, flocculation, clarification and filtration.
7. Sediment Removal	40,400 gallons	Removal of sediments from ponded areas.
8. Sludge and Sediment Dewatering	41,400 gallons	Dewatering 1000 gallons chemical sludge and 40,400 gallon sediments.
9. Recharge of Treated Water	1,000,000 gallons	Recharge of treated water to groundwater.
10. Off-site Disposal of Sludge and Sediments	358 tons	Transportation, treatment and disposal of dewatered sludge (Assume 30% solids).
11. Drainage Clearance	Lump Sum	Clean plugged drainage to restore drainage
12. Health and Safety	Lump Sum	Health and Safety equipments and monitoring.

TABLE A-9

ALTERNATIVE SW-3: OFF-SITE TREATMENT AND DISPOSAL

MAJOR FACILITIES AND CONSTRUCTION COMPONENTS

<u>ITEM</u>	<u>ESTIMATED QUANTITIES</u>	<u>DESCRIPTION</u>
1. Office and Decontamination Trailer	1	Lease for six months, office and health and safety trailer with shower facility. Includes site preparation, set up, utilities, decontamination water storage and treatment. Size 30 ft L x 7.5 ft W x 7 ft H.
2. Pumping, Collection and Transportation	1,000,000 gallons	Pumping ponded water, collection in tanker trucks or rail cars and transportation to off-site treatment and disposal facility (Assume 100 mile distance)
3. Off-Site Treatment and Disposal of Standing Water	1,000,000 gallons	Off-Site treatment and disposal of standing water.
4. Sediment Removal	40,400 gallons	Removal of sediments from ponded water.
5. Off-site Treatment and Disposal of Sediments	40,400 gallons	Off-site treatment and disposal of sediments.
6. Drainage Clearance	Lump Sum	Clean plugged drainage to restore drainage.
7. Health and Safety	Lump Sum	Health and Safety equipment and monitoring.

APPENDIX B

BREAKDOWN OF CAPITAL AND OPERATION
AND MAINTENANCE COST ESTIMATES
FOR REMEDIAL ALTERNATIVES

TABLE B-1

ALTERNATIVE SP-1: NO ACTION

CAPITAL COST ESTIMATES (1991 DOLLARS)

<u>ITEM</u>	<u>ESTIMATED QUANTITIES</u>	<u>UNIT PRICE</u>	<u>COST</u>
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No Additional Actions Required.

TABLE B-2

ALTERNATIVE SP-3: OFF-SITE FLAME REACTOR

CAPITAL COST ESTIMATES (1991 DOLLARS)

<u>ITEM</u>	<u>ESTIMATED QUANTITIES</u>	<u>UNIT PRICE</u>	<u>COST*</u>
1. Office and Decontamination Trailer	1	92,300/each	92,300
2. Bench/Pilot Scale Treatability Test	Lump Sum	50,000	50,000
3. Removal and Handling	10,000 cy (12,000 tons)	8/cy	80,000
4. Transportation	12,000 tons	0.2/ton-mile	480,000
5. Flame Reactor Treatment	12,000 tons	200/ton	2,400,000
6. Recycling and disposal of residues	12,000 tons	No Cost	0
7. Health and Safety	Lump Sum	20,000	<u>20,000</u>
Total Direct Cost (TDC)			3,122,300
Contingency @ 20% of TDC			624,500
Engineering @ 10% of TDC			312,200
Legal and Administrative @ 5% of TDC			<u>156,100</u>
Total Capital Cost			4,215,100

* All numbers are rounded to nearest hundred.

TABLE B-3

ALTERNATIVE SP-4: ON-SITE HYDRO-METALLURGICAL LEACHING/ON-SITE

CAPITAL COST ESTIMATES (1991 DOLLARS)

<u>ITEM</u>	<u>ESTIMATED QUANTITIES</u>	<u>UNIT PRICE</u>	<u>COST*</u>
1. Office Trailer	2	5,300/each	10,600
2. Decontamination Trailer	1	87,000/each	87,000
3. Bench/Pilot Scale Treatability Test	Lump Sum	150,000	150,000
4. Mobilization/Demobilization	Lump Sum	400,000	400,000
5. Removal and Handling	10,000 cy	21.30/cy	213,000
6. Hydro-metallurgical Leaching	10,000 cy	130/cy	1,300,000
7. Recycle Recovered Lead	1,250 tons	45/ton (credit)	56,300 (credit)
8. Disposal	10,000 cy	4.34/cy	43,400
9. Health and Safety	Lump Sum	60,000	<u>60,000</u>
Total Direct Cost (TDC)			2,207,700
Contingency @ 20% of TDC			441,500
Engineering @ 10% of TDC			220,800
Legal and Administrative @ 5% of TDC			<u>110,400</u>
Total Capital Cost			2,980,400

* All numbers are rounded to nearest hundred.

TABLE B-4

ALTERNATIVE SP-5: ON-SITE STABILIZATION (SOLIDIFICATION) ON-SITE DISPOSAL

CAPITAL COST ESTIMATES (1991 DOLLARS)

<u>ITEM</u>	<u>ESTIMATED QUANTITIES</u>	<u>UNIT PRICE</u>	<u>COST*</u>
1. Officer Trailer	2	5,300/each	10,600
2. Decontamination Trailer	1	8,700/each	87,000
3. Mobilization/Demobilization	Lump Sum	100,000	100,000
4. Bench/Pilot Scale Treatability Test	Lump Sum	50,000	50,000
5. Removal and Handling	10,000 cy	12.34/cy	123,400
6. On-Site Stabilization/Solidification	10,000 cy	100/cy	1,000,000
7. Disposal	14,000 cy	4.34/cy	60,800
8. Health and Safety	Lump Sum	60,000	<u>60,000</u>
Total Direct Cost (TDC)			1,491,800
Contingency @ 20% of TDC			298,400
Engineering @ 10% of TDC			149,200
Legal and Administrative @ 5% of TDC			<u>74,600</u>
Total Capital Cost			2,014,000

* All numbers are rounded to nearest hundred.

TABLE B-5

ALTERNATIVE CS-1: NO ACTION

CAPITAL COST ESTIMATES (1991 DOLLARS)

<u>ITEM</u>	<u>ESTIMATED QUANTITIES</u>	<u>UNIT PRICE</u>	<u>COST*</u>
1. Building Roof Repair	13,100 ft ²	1/ft ²	<u>13,100</u>
		Total Direct Cost (TDC)	13,100
		Contingency @ 20% of TDC	2,600
		Engineering @ 10% of TDC	1,300
		Legal and Administrative @ 5% of TDC	<u>700</u>
		Total Capital Cost	17,700

* All numbers are rounded to nearest hundred.

TABLE B-6

ALTERNATIVE CS-2: DEBRIS AND CONTAMINATED SURFACES (BUILDINGS AND EQUIPMENTS) DECONTAMINATION/OFF-SITE TREATMENT AND DISPOSAL

CAPITAL COST ESTIMATES (1991 DOLLARS)

<u>ITEM</u>	<u>ESTIMATED QUANTITIES</u>	<u>UNIT PRICE</u>	<u>COST*</u>
1. Office Trailer	2	5,300/each	10,600
2. Decontamination Trailer	1	87,000/each	87,000
3. Building Roof Repair	13,100 ft ²	1/ft ²	13,100
4. Dusting/vacuuming/wiping	40,000 sy	5/sy	200,000
5. Hydroblasting	20,000 sy	15/sy	300,000
6. Off-site Treatment and Disposal of Dust	70 cy (85 tons)	835/ton	71,000
7. Treatment/Disposal of Water from Hydroblasting	810,000 gallons	0.35/gallon	283,500
8. Off-site Disposal of Decontaminated Debris	2500 cy	91/cy	227,500
9. Health and Safety	Lump Sum	60,000	<u>60,000</u>
		Total Direct Cost (TDC)	1,252,700
		Contingency @ 20% of TDC	250,500
		Engineering @ 10% of TDC	125,300
		Legal and Administrative @ 5% of TDC	<u>62,600</u>
		Total Capital Cost	1,691,100

* All numbers are rounded to nearest hundred.

TABLE B-7

ALTERNATIVE SW-1: NO ACTION

CAPITAL COST ESTIMATES (1991 DOLLARS)

<u>ITEM</u>	<u>ESTIMATED QUANTITIES</u>	<u>UNIT PRICE</u>	<u>COST</u>
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No Additional Actions Required.

TABLE B-8

ALTERNATIVE SW-2: ON-SITE TREATMENT AND GROUNDWATER RECHARGE

CAPITAL COST ESTIMATES (1991 DOLLARS)

<u>ITEM</u>	<u>ESTIMATED QUANTITIES</u>	<u>UNIT PRICE</u>	<u>COST*</u>
1. Office Trailer	2	5,300/each	10,600
2. Decontamination Trailer	1	87,000/each	87,000
3. Mobilization/Demobilization	Lump Sum	100,000	100,000
4. Bench/Pilot Scale Treatability Test	Lump Sum	50,000	50,000
5. Pumping and Collection	Lump Sum	6,000	6,000
6. pH Adjustment, Chemical Precipitation, Flocculation, Clarification, Filtration, Polishing	1,000,000 gallons	0.45/gallon	450,000
7. Sediment Removal	40,400 gallons	0.33/gallon	13,300
8. Sludge and Sediment Dewatering	41,400 gallons	Lump Sum	10,000
9. Recharge of Treated Water	1,000,000 gallons	Lump Sum	52,000
10. Off-site Disposal of Sludge and Sediments	358 tons	405/ton	145,000
11. Drainage Clearance	Lump Sum	5,000	5,000
12. Health and Safety	Lump Sum	60,000	<u>60,000</u>
Total Direct Cost (TDC)			988,900
Contingency @ 20% of TDC			197,800
Engineering @ 10% of TDC			98,900
Legal and Administrative @ 5% of TDC			<u>49,400</u>
Total Capital Cost			1,335,000

* All numbers are rounded to nearest hundred.

TABLE B-9

ALTERNATIVE SW-3: OFF-SITE TREATMENT AND DISPOSAL

CAPITAL COST ESTIMATES (1991 DOLLARS)

<u>ITEM</u>	<u>ESTIMATED QUANTITIES</u>	<u>UNIT PRICE</u>	<u>COST*</u>
1. Office and Decontamination Trailer	1	92,300/each	92,300
2. Pumping, Collection and Transportation	1,000,000 gallons	0.1/gallon	100,000
3. Off-Site Treatment and Disposal of Standing Water	1,000,000 gallons	0.35/gallon	350,000
4. Sediment Removal	40,400 gallons	0.33/gallon	13,300
5. Off-site Treatment and Disposal of Sediments	40,400 gallons	3.84/gallon	155,100
6. Drainage Clearance	Lump Sum	5,000	5,000
7. Health and Safety	Lump Sum	20,000	<u>20,000</u>
Total Direct Cost (TDC)			735,700
Contingency @ 20% of TDC			147,100
Engineering @ 10% of TDC			73,600
Legal and Administrative @ 5% of TDC			<u>36,800</u>
Total Capital Cost			993,200

* All numbers are rounded to nearest hundred.

TABLE B-10

ALTERNATIVE SP-1: NO ACTION

ANNUAL OPERATION AND MAINTENANCE COST ESTIMATES (1991 DOLLARS)

<u>Item</u>	<u>Basis of Estimate</u>	<u>Annual O&M Cost Estimate*</u>	<u>Year</u>
I. MONITORING			
1. Soil and Water Sampling	2 persons @ \$30/hr 40 hrs/year	2,400.00	1-30
2. Soil Laboratory Analysis	8 soil samples @ \$800/sample	6,400.00	1-30
3. Water Laboratory Analysis	12 water samples @ \$600/sample	7,200.00	1-30
4. Report	1 person @ \$60/hr - 80 hrs/year	4,800.00	1-30
II. MAINTENANCE			
1. Fence Repair	500 ft/year @ \$6/ft	3,000.00	1-30
III. CONTINGENCY	5% of annual O&M cost	1,200.00	1-30
Total Annual O&M Cost		25,000.00	1-30
Present Worth of O&M**		384,300.00	
IV. FIVE YEAR REVIEWS AND PUBLIC AWARENESS PROGRAMS	\$20,000/review		
Present Worth of Reviews		55,600.00	5, 10, 15, 20, 25 & 30
Total Present Worth of O&M**		439,900.00	

* All numbers are rounded to nearest hundred

** Present worth analysis based on 30-year period and 5 percent discount rate

TABLE B-11

ALTERNATIVE SP-4: ON-SITE HYDRO-METALLURGICAL LEACHING/ON-SITE DISPOSAL

ANNUAL OPERATION AND MAINTENANCE COST ESTIMATES* (1991 DOLLARS)

<u>Item</u>	<u>Basis of Estimate</u>	<u>Annual O&M Cost Estimate**</u>	<u>Year</u>
I. MONITORING			
1. Soil and Water Sampling	2 persons @ \$30/hr 40 hrs/year	2,400.00	1-30
2. Soil Laboratory Analysis	4 soil samples @ \$800/sample	3,200.00	1-30
3. Water Laboratory Analysis	6 water samples @ \$600/sample	3,600.00	1-30
4. Report	1 person @ \$60/hr - 60 hrs/year	3,600.00	1-30
II. MAINTENANCE			
1. Fence Repair	500 ft/year @ \$6/ft	3,000.00	1-30
III. CONTINGENCY	5% of annual O&M cost	1,200.00	1-30
Total Annual O&M Cost		17,000.00	1-30
Present Worth of O&M***		261,300.00	
IV. FIVE YEAR REVIEWS AND PUBLIC AWARENESS PROGRAMS	\$10,000/review		
Present Worth of Reviews		27,800.00	5, 10, 15, 20, 25 & 30
Total Present Worth of O&M***		289,100.00	

* Only required for on-site disposal option

** All numbers are rounded to nearest hundred

*** Present worth analysis based on 30-year period and 5 percent discount rate

TABLE B-12

ALTERNATIVE SP-5: ON-SITE STABILIZATION (SOLIDIFICATION)/ON-SITE DISPOSAL

ANNUAL OPERATION AND MAINTENANCE COST ESTIMATES* (1991 DOLLARS)

<u>Item</u>	<u>Basis of Estimate</u>	<u>Annual O&M Cost Estimate**</u>	<u>Year</u>
I. MONITORING			
1. Soil and Water Sampling	2 persons @ \$30/hr 40 hrs/year	2,400.00	1-30
2. Soil Laboratory Analysis	4 soil samples @ \$800/sample	3,200.00	1-30
3. Water Laboratory Analysis	6 water samples @ \$600/sample	3,600.00	1-30
4. Report	1 person @ \$60/hr - 60 hrs/year	3,600.00	1-30
II. MAINTENANCE			
1. Fence Repair	500 ft/year @ \$6/ft	3,000.00	1-30
III. CONTINGENCY	5% of annual O&M cost	1,200.00	1-30
Total Annual O&M Cost		17,000.00	1-30
Present Worth of O&M***		261,300.00	
IV. FIVE-YEAR REVIEWS AND PUBLIC AWARENESS PROGRAMS	\$10,000/review		
Present Worth of Reviews		27,800.00	5, 10, 15, 20, 25 & 30
Total Present Worth of O&M***		289,100.00	

* Only required for on-site disposal option

** All numbers are rounded to nearest hundred

*** Present worth analysis based on 30-year period and 5 percent discount rate

TABLE B-13

ALTERNATIVE CS-1: NO ACTION

ANNUAL OPERATION AND MAINTENANCE COST ESTIMATES (1991 DOLLARS)

<u>Item</u>	<u>Basis of Estimate</u>	<u>Annual O&M Cost Estimate*</u>	<u>Year</u>
I. MONITORING			
1. Routine Inspection	1 persons @ \$30/hr 2 hrs/wk	3,100.00	1-30
4. Report	1 person @ \$60/hr - 40 hrs/year	2,400.00	1-30
II. MAINTENANCE			
1. Roof Maintenance	1000 ft ² /yr @ \$1.0/ft ²	1000.00	1-30
III. CONTINGENCY	5% of annual O&M cost	300.00	1-30
Total Annual O&M Cost		6,800.00	1-30
Present Worth of O&M**		104,500.00	1-30
IV. FIVE-YEAR REVIEWS AND PUBLIC AWARENESS PROGRAMS	\$5,000/review		
Present Worth of Reviews		13,900.00	1-30
Total Present Worth of O&M**		118,400.00	

* All numbers are rounded to nearest hundred

** Present worth analysis based on 30-year period and 5 percent discount rate

TABLE B-14

ALTERNATIVE SW-1: NO ACTION

ANNUAL OPERATION AND MAINTENANCE COST ESTIMATES (1991 DOLLARS)

<u>Item</u>	<u>Basis of Estimate</u>	<u>Annual O&M Cost Estimate*</u>	<u>Year</u>
I. MONITORING			
1. Water Sampling	2 persons @ \$30/hr 20 hrs/year	1,200.00	1-30
2. Water Laboratory Analysis	6 water samples @ \$600/sample	3,600.00	1-30
4. Report	1 person @ \$60/hr - 40 hrs/year	2,400.00	1-30
II. MAINTENANCE			
1. Fence Repair	500 ft/year @ \$6/ft	3,000.00	1-30
III. CONTINGENCY	5% of annual O&M cost	500.00	1-30
Total Annual O&M Cost		10,700.00	1-30
Present Worth of O&M**		164,500.00	
IV. FIVE-YEAR REVIEWS AND PUBLIC AWARENESS PROGRAMS	\$20,000/review		
Present Worth of Reviews		55,600.00	5, 10, 15, 20, 25 & 30
Total Present Worth of O&M**		220,100.00	

* All numbers are rounded to nearest hundred

** Present worth analysis based on 30-year period and 5 percent discount rate